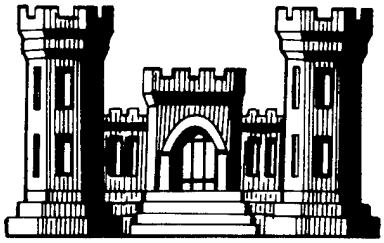

US Army Corps of Engineers
Europe Division

1983

PHASE III SUBMITTAL
Volume 1 of 2
Executive Summary

EEAP FY 83 Package No. 17
Contract DACA90-83-C-0017
Heilbronn Military Community

FINAL SUBMITTAL (100%)

LOCKWOOD GREENE

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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PHASE III SUBMITTAL CONTENTS

VOLUME I EXECUTIVE SUMMARY

VOLUME II PROJECT FUNDING DOCUMENTATION

1.1 Purpose

The purpose of the Energy Engineering Analysis Program (EEAP) is to develop a systematic plan for reducing overall energy consumption at the Heilbronn Military Community in West Germany. This report and the resulting funding documentation establish guidelines for EEAP management action to accomplish this goal. Further, these materials have been prepared in accordance with the Army Facilities Energy Plan and the Schedule of Services.

Phase I of the EEAP was a data gathering phase, the intent of which was to collect sufficient information on which to prepare a comprehensive community energy report. Phase II of the study was the actual preparation of the Energy Report. The report is made up of energy conservation studies which establish methods of energy reduction as well as their corresponding savings-to-investment ratios. Phase III of the study is the development of project documentation for funding of the various energy conservation measures that are to be implemented.

1.2 Scope

The scope of this project is outlined in the Schedule of Title I Services dated 10 January 1983. A copy is included in the appendix of Volume II of this submittal. The preparation of the report required physical inspections of the majority of heated structures that are a part of the overall Heilbronn community. These "walk-through" inspections included analyses of building uses and methods of heating as well as interviews with Heilbronn personnel.

During these inspections, energy waste was observed and documented. Energy Conservation Opportunities (ECO's) were noted on a building-by-building basis, and a "Quick Fix" list was prepared. This list was given to the housing officer and the energy conservation coordinator during the inspection team's exit interview and was published as part of the Phase I field data summary.

For purposes of computer modeling, a specified building list was selected. This list was used to establish actual lighting loads, actual glass area, condition of the structures, operational patterns, calculated heat transfer factors ("U" or "R" values), number of occupants, and other information required for proper computer modeling of an operating structure.

A total of twenty four buildings were inspected as detailed above and were subsequently modeled. The results were used for determining a theoretical total energy consumption for the community. The results were also used to determine savings-to-investment ratios in order to establish the quality of an improvement.

The modeling method agreed upon was the Trane Air Conditioning Economics program (TRACE). This program, which is used for both heating and air conditioning, is based on American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) research data.

Section 2.0 Energy Conservation Opportunities (ECO's)

2.1 Description of ECO's Studied

2.1.1 The following is a list of all Energy Conservation Opportunities (ECO's) investigated for the Heilbronn Community. The numbering system is established to facilitate handling each ECO by assigning it to the proper program increment and for simplified reference from written text. ECO's which deal primarily with building and system improvements are numbered numerically, and ECO's for boiler plant and distribution systems include the GY number to assist in identification.

ECO-000-1: Zone existing multiple-use facilities throughout the Heilbronn Community to reduce energy consumption in minimal use areas.

ECO-000-2: Reschedule utilization of existing facilities throughout Heilbronn to reduce energy consumption.

ECO-000-3: Consolidate services throughout Heilbronn into permanent buildings through alteration or new construction.

ECO-000-4: Decrease electric power consumption by automatically controlling interior lighting levels.

ECO-000-5: Convert existing steam distribution systems throughout Heilbronn to hot water in order to minimize distribution system energy losses.

ECO-000-6: Recover waste heat from messhalls, laundries, and refrigeration equipment.

ECO-000-7: Install heat pumps in all areas with central domestic hot water systems to supplement generation of domestic hot water.

ECO-000-8: Decentralize domestic hot water heating by installing electric hot water generators in all living quarters throughout Heilbronn.

ECO-000-9: Limit availability of all domestic hot water to certain hours during the day.

ECO-000-10: Reduce temperature of all domestic hot water.

ECO-000-11: Insulate all existing domestic hot water storage tanks.

ECO-000-12: Install shower flow restrictors throughout Heilbronn.

ECO-000-13: Improve overall exterior lighting efficiency by delamping (reducing lighting level) and relamping.

ECO-000-14: Improve overall interior lighting efficiency by delamping (reducing lighting level) and relamping with more energy efficient lights.

Note: This ECO should be funded under normal operating and maintenance guidelines.

ECO-000-15: Improve existing fluorescent interior lighting efficiency by installing high efficiency ballasts and tubes on fluorescent fixtures.

ECO-000-16: Employ spot heaters or warming rooms where possible in lieu of unit heaters. Improve air stratification.

ECO-000-17: Improve existing building heat loss by insulating basement ceilings, walls, attic floors, and roofs.

ECO-000-18: Improve existing building infiltration by replacing broken windows and door closures and sealing with caulking and weather stripping, door repairs and vestibules.

ECO-000-19: Improve existing building heat loss by installing storm or energy efficient windows, double glazing existing windows, reducing window area, installing translucent panels, etc.

ECO-000-20: Improve control systems for building heating to stabilize temperatures. This is accomplished by utilizing room thermostat controlled valves on steam radiators and outside temperature control on water heated buildings.

ECO-000-21: Reduce utility demand charges where possible by peak load shedding.

ECO-000-22: Install peak shaving electric generators to reduce utility demand charges.

ECO-000-23: Improve power factors throughout the community to reduce utility charges.

ECO-000-24: Improve existing heat distribution system heat losses in all areas by reinsulating poorly insulated piping and optimizing insulation thicknesses for all distribution piping.

ECO-000-25: Improve condensate return systems by replacing and maintaining steam traps.

ECO-000-26: Improve existing distillate oil-fired boiler operating efficiencies by installing flue gas dampers and fire tube boiler turbulators.

ECO-000-27: Improve existing oil-fired boiler burner control systems by utilizing oxygen trim.

ECO-000-28: Install heat exchangers to recover heat from boiler continuous blowdown.

ECO-000-29: (NOTE: Condensate receivers in good working condition; therefore, this ECO is not required.)

ECO-000-30: Replace existing street lighting with high pressure sodium fixtures.

ECO-000-31: Improve energy distribution by determining high energy consumption areas using energy meters.

ECO-063-1: Improve existing heating plant overall efficiency in Artillery (GY-063) by insulating presently uninsulated valves, strainers, and equipment; increasing insulation thickness on equipment; reconditioning poorly operating burners.

ECO-071-1: Improve existing heating plant overall efficiency in the Badenerhof Kaserne (GY-071) by insulating presently uninsulated valves, strainers, piping, and equipment, increasing insulation thickness on equipment.

ECO-071-2: This Energy Conservation Opportunity consists of expanding the existing #6 fuel oil-fired central heating plant in Building 301 to supply steam heating to all buildings in Badenerhof Kaserne (GY-071). This will require additional boiler capacity and expansion of the steam distribution system.

ECO-202-1: Improve existing heating plant overall efficiency Kennedy Village (GY-202) by insulating presently uninsulated valves and strainers and increasing insulation thickness on equipment.

ECO-202-2: This Energy Conservation Opportunity consists of expandinig the existing #6-fired central heating plant in Building 262 to supply steam heating to all buildings in Kennedy Family Housing (GY-202). This will require additional boiler capacity and expansion of the hot water distribution system; however, it will idle several small heating plants.

ECO-248-1: Improve existing heating plant overall efficiency in the Schwaebisch Hall (GY-248) by insulating presently uninsulated valves and strainers, reconditioning poorly operating burners.

ECO-248-2: This Energy Conservation Opportunity consists of constructing a new central heating plant to supply steam heating to all buildings in Dolan Barracks (GY-248). This will require a new boiler and building, expansion of the steam distribution system and some steam to hot water heat exchangers; however, it will idle many small heating plants.

ECO-422-1: Improve existing heating plant overall efficiency in Dallau (GY-422) by insulating presently uninsulated valves, strainers, and equipment; increasing insulation thickness on piping and equipment; and reconditioning poorly operating burner.

ECO-422-2: This Energy Conservation Opportunity consists of expanding the existing #2 oil-fired central heating plant in Building 4053 to supply hot water heating to buildings 4051-4054, 4017, 4061, 4064 and 4066 of Dallau Launch Area (GY-422). This will require expansion of the hot water distribution system.

ECO-449-1: Improve existing heating plant overall efficiency in Siegelsbach (GY-449) by insulating presently uninsulated valves, strainers, and equipment; increasing insulation thickness on piping and equipment; reconditioning poorly operating burners.

ECO-638-1: Improve existing heating plant overall efficiency in Heilbronn Training Area (GY-638) by insulating presently uninsulated valves and strainers.

ECO-694-1: This ECO is concerned with improving the existing heat plant efficiencies in Wharton Barracks (GY-694) by insulating presently uninsulated valves, strainers, and equipment, increasing the insulatiton thickness on equipment, and reconditioning poorly operating burners.

The project funding documentation identification system is in most cases similar to the ECO identification number. The typical exceptions are shown below:

ECO Number	Project Funding Documentation
ECO-000-10	ECO-000-10(MH) Military Housing (buildings) ECO-000-10(FH) Family Housing
ECO-202-1, ECO-248-1, ECO-449-1, ECO-638-1 and ECO-694-1	ECO-XXX-1 combined for funding; Note: areas that are candidates for central heating plants were excluded from ECO-XXX-1
ECO-000-6 ECO-000-28	ECO-000-6A, Note: This ECO was dropped due to a low SIR. ECO-000-6B and ECO-000-28(1) reflect a revision in scope and/or funding increment from the original concept.
Energy Management Control Systems - EMCS	EMC-694, Energy Management Control System for GY Area 694

2.1.2 Grouping of ECOs For Project Funding Documentation

Several ECOs have been combined to produce fewer Project Funding Documents. This grouping was requested by the community. Heilbronn grouping is as follows:

Combine ECO-000-13, ECO-000-20, and EMC-248 FH into one ECIP Project.

Combine ECO-XXX-1 without Family Housing, ECO-000-28, ECO-000-26, ECO-000-18 without Family Housing ECO-000-30 and ECO-000-13 without family housing into one ECIP Project.

Combine ECO-XXX-1 Family Housing, ECO-000-24, ECO-000-18 Family Housing and ECO-000-26 into one ECIP Project.

2.2 Summary of ECO's

Each Energy Conservation Opportunity (ECO) analyzed is listed in Table 1 which shows the numerical ranking of all ECO's for Heilbronn by SIR. This table also includes the ESIR, construction cost, assigned increment, energy and cost saved the first year and simple amortization.

Five (5) ECO's (000-1, 000-3, 000-23, 000-27, 000-29) were evaluated for energy savings and found to have no potential and are therefore not listed.

Tables 2 and 3 are summaries of energy and cost savings by fuel type for each of the ECO's. These values are before interaction. Refer to Section 3 for the systematic Energy Plan and interacted values. The table entitled "Project Funding Documentation" is a listing of all ECO's that have been selected for implementation and for which funding documentation has been prepared. The actual funding documentation appears in Volume 2.

HEILBRONN MILITARY COMMUNITY

TABLE 1

ECO NUMERICAL RANKING, INCREMENT AND COST

ECO NO	SIR	ESIR	CONST COST	ASSIGNED INCREMENT	ENERGY SAVED 1ST YR MILLION BTU	ENERGY($) SAVED 1ST YR	SIMPLE AMORTIZATION
000-10(MH)	139.58	139.58	16,484	G	25,101	1,777,445	1.10
000-10	116.40	116.40	31,000	G	66,302	468,126	0.70
000-12	81.60	81.60	31,720	G	28,989	2,000,810	1.90
422-2	67.90	67.90	1,372	G	952	8,302	0.20
XXX-1	65.80	65.80	89,800	G	64,412	476,796	0.19
000-10(FH)	59.65	59.65	12,858	G	8,367	59,149	2.60
000-20(FH)	37.53	37.53	38,475	G	15,670	114,347	0.33
248-1	32.65	32.65	29,261	G	9,907	76,895	0.40
071-1	31.46	31.46	11,230	G	4,062	24,186	0.50
638-1	24.47	24.47	3,370	G	843	7,351	0.50
202-1	20.73	20.73	19,500	G	4,267	32,313	1.70
449-1	20.42	20.42	4,800	G	1,002	8,737	0.60
071-2	18.65	15.76	69,537	G	-7,524	43,768	2.00
000-2	18.60	18.60	11,710	G	2,550	16,149	0.73
25-2	14.75	14.75	260,860	B	33,645	220,178	0.89
000-20(MH)	11.67	11.67	852,700	B	85,835	577,080	1.11
000-25	9.91	9.91	271,128	B	33,673	220,482	1.00
063-1	9.87	9.87	12,000	G	1,314	8,205	1.50
000-20	9.45	9.45	844,329	A	91,136	629,834	1.30
000-6B	8.85	8.85	15,576	G	1,487	10,946	1.40
694	7.70	7.70	520,000	B	41,465	249,534	1.80
000-28	5.37	5.37	40,158	G	2,606	16,085	0.60
000-16	4.73	4.73	407,000	B	16,424	111,302	2.80
248	4.58	4.58	732,000	B	27,477	208,808	2.80
000-21	4.51	0.00	479,277	G	0	0	
000-28(1)	4.19	4.19	65,100	B	2,606	16,085	4.05
248-2	4.15	4.15	1,388,558	B	24,681	417,530	3.00
000-14	4.14	4.14	306,100	A	24,285	125,553	2.00
000-24	4.04	4.04	1,104,737	B	70,664	467,926	2.00
000-26(MH)	3.77	3.77	90,300	B	2,745	23,991	3.00
000-24(MH)	3.28	3.28	1,616,500	B	44,337	343,709	4.70
063	3.08	3.08	275,000	B	10,703	65,355	5.60
202	2.98	2.98	1,320,000	B	9,696	57,725	3.80
071	2.98	2.98	247,000	B	30,647	229,096	6.30
000-24(FH)	2.68	2.68	154,200	F	3,418	21,802	7.07
000-18	2.65	2.65	215,926	B	7,695	55,539	3.80
000-30	2.60	2.60	15,522	F	716	3,659	4.20
000-30(1)	2.51	2.51	20,953	F	945	4,829	4.00
000-6A	2.29	2.29	260,598	A	7,072	48,771	5.30
000-26(FH)	1.98	1.98	122,200	B	951	7,052	5.60
694-1	1.55	1.55	233,000	B	4,576	27,705	8.40
449	1.46	1.46	342,000	B	6,483	55,871	9.30
422-1	1.44	1.44	38,300	G	563	4,909	7.80
000-31	1.42	1.42	274,728	A	5,405	32,265	8.00
000-30(2)	1.40	1.40	15,073	F	381	1,947	8.00
000-13	1.20	1.20	101,325	F	2,018	10,312	9.70

HEILBRONN MILITARY COMMUNITY

TABLE 1

ECO NUMERICAL RANKING, INCREMENT AND COST

ECO NO	SIR	ESIR	CONST COST	ASSIGNED INCREMENT	ENERGY SAVED 1ST YR MILLION BTU	ENERGY($) SAVED 1ST YR	SIMPLE AMORTIZATION
000-17	1.19	1.19	2,528,526	A	35,112	235,883	10.70
202-2	1.12	-0.20	739,887	G	-17,685	60,040	12.00
000-30(3)	1.05	1.05	78,228	F	559	7,581	10.00
000-11D	0.96	0.96	33,618		359	2,132	16.00
000-5	0.93	0.93	1,024,470		11,106	68,847	15.00
000-26	0.91	0.91	130,500		1,217	10,637	12.20
000-19	0.83	0.83	563,314		4,924	37,386	15.00
000-15	0.70	0.70	7,057		93	475	15.00
000-11A	0.68	0.68	163,282		1,207	8,924	19.00
000-11B	0.64	0.64	96,244		627	5,467	18.00
000-11C	0.52	0.52	33,421		221	1,324	25.00
000-7	0.43	-0.37	166,514		-1,123	-5,121	-32.50
000-4	0.28	0.28	14,700		75	384	38.00
000-22	0.16	0.16	51,600		-83	2,225	-23.00
000-9	---	---	NONE	N/A	VARIABLE	VARIABLE	N/A
000-8B	-0.35	-1.10			10,413	-20,626	-4.00

HEILBRONN MILITARY COMMUNITY

TABLE 2

SUMMARY OF ENERGY SAVINGS BY FUEL TYPE

			ENERGY SAVED MILLION BTU 1ST YR			
ECO NO.	SIR	COST ($1000)	ELECT	DIST	RESI	COAL
000-10(MH)	139.58	16.48	---	10,088.00	6,010.00	9,003.00
000-10	116.40	31.38	0.00	16,519.00	9,841.00	14,742.00
000-12	81.60	31.72	----	10,085.00	11,582.00	7,322.00
422-2	67.90	1.38	0.00	952.00	0.00	0.00
XXX-1	65.80	89.80	----	34,789.00	10,546.00	19,077.00
000-10(FH)	59.65	12.85	----	3,363.00	2,003.00	3,001.00
000-20(FH)	37.53	38.47	----	7,579.00	3,943.00	4,148.00
248-1	32.65	29.26	0.00	6,492.00	0.00	3,415.00
071-1	31.46	11.37	0.00	0.00	1,153.00	2,909.00
638-1	24.47	3.41	0.00	843.00	0.00	0.00
202-1	20.73	19.74	0.00	2,506.00	0.00	1,761.00
449-1	20.42	4.86	0.00	1,002.00	0.00	0.00
000-2	18.60	11.85	0.00	340.00	1,274.00	936.00
071-2	15.76	70.40	0.00	0.00	-12,793.00	20,269.00
25-2	14.75	260.86	----	7,693.00	14,726.00	11,226.00
000-20(MH)	11.67	852.70	----	23,505.00	37,514.00	24,816.00
000-20	10.56	854.88	0.00	31,084.00	41,457.00	29,014.00
000-25	9.91	274.73	0.00	7,721.00	18,183.00	5,574.00
063-1	9.87	12.15	0.00	142.00	107.00	1,065.00
694	7.70	520.00	371.00	544.00	40,550.00	0.00
000-28	5.37	40.66	0.00	185.00	1,817.00	604.00
000-16	4.73	407.00	-84.00	4,838.00	4,437.00	7,233.00
248	4.58	732.00	372.00	16,512.00	0.00	10,593.00
000-21	4.51	485.26	0.00	0.00	0.00	0.00
000-6B	4.48	15.77	-21.00	754.00	0.00	0.00
000-28(1)	4.19	65.10	0.00	185.00	1,817.00	604.00
248-2	4.15	1,405.91	0.00	99,552.00	-116,570.00	41,699.00
000-14	4.14	309.92	24,285.00	0.00	0.00	0.00
000-24	4.04	1,118.54	0.00	17,036.00	16,426.00	16,801.00
000-26(MH)	3.77	90.30	----	2,745.00	----	----
000-24(MH)	3.28	1,616.50	0.00	28,859.00	2,381.00	13,097.00
063	3.08	275.00	234.00	595.00	6,381.00	3,493.00
071	2.98	247.00	348.00	16,815.00	11,924.00	1,560.00
202	2.98	1,320.00	172.00	0.00	5,479.00	4,045.00
000-17	2.86	288.09	0.00	2,173.00	3,812.00	3,358.00
000-24(FH)	2.68	154.20	0.00	537.00	133.00	2,748.00
000-18	2.65	215.93	22.00	3,501.00	2,315.00	1,857.00
000-30	2.60	15.52	716.00	0.00	0.00	0.00
000-30(1)	2.51	21.21	945.00	0.00	0.00	0.00
000-6A	2.11	130.50	-185.00	636.00	1,681.00	1,252.00
000-26(FH)	1.98	122.20	----	951.00	----	----
694-1	1.55	235.91	0.00	108.00	4,468.00	0.00
000-30(3)	1.50	20.92	559.00	0.00	0.00	0.00
449	1.46	342.00	183.00	6,300.00	0.00	0.00
422-1	1.44	38.77	0.00	563.00	0.00	0.00
000-31	1.42	278.16	2,500.00	778.00	1,439.00	688.00
000-30(2)	1.40	15.26	381.00	0.00	0.00	0.00
000-13	1.20	101.33	2,018.00	0.00	0.00	0.00

HEILBRONN MILITARY COMMUNITY

TABLE 2

SUMMARY OF ENERGY SAVINGS BY FUEL TYPE

			ENERGY SAVED MILLION BTU 1 ST YR			
ECO NO.	SIR	COST ($1000)	ELECT	DISTI	RESI	COAL
202-2	1.12	749.13	0.00	61,411.00	-88,969.00	9,673.00
000-9	----	0.00	0.00	474.00	272.00	0.00
TOTAL		14,006.38	32,816.00	430,755.00	45,339.00	277,583.00

HEILBRONN MILITARY COMMUNITY

TABLE 3

SUMMARY OF COST SAVINGS BY FUEL TYPE

	ENERGY DOLLARS SAVED 1 ST YR			
ECO NO	ELECT	DIST	RESI	COAL
000-10(MH)	0.00	87,967.36	35,999.90	53,477.82
000-10	0.00	144,045.68	58,947.59	87,567.48
000-12	0.00	87,941.20	69,376.18	43,492.68
422-2	0.00	8,301.44	0.00	0.00
XXX-1	0.00	303,360.08	63,170.54	113,317.38
000-10(FH)	0.00	29,325.36	11,997.97	17,825.94
000-20(FH)	0.00	66,088.88	23,618.57	24,639.12
248-1	0.00	56,610.24	0.00	20,285.10
071-1	0.00	0.00	6,906.47	17,279.46
638-1	0.00	7,350.96	0.00	0.00
202-1	0.00	21,852.32	0.00	10,460.34
449-1	0.00	8,737.44	0.00	0.00
000-2	0.00	2,964.80	7,631.26	5,559.84
071-2	0.00	0.00	-76,630.07	120,397.86
25-2	0.00	67,082.96	88,208.74	66,682.44
000-20(MH)	0.00	204,963.60	224,708.86	147,407.04
000-20	0.00	271,052.48	248,327.43	172,343.16
000-25	0.00	67,327.12	108,916.17	33,109.56
063-1	0.00	1,238.24	640.93	6,326.10
694	1,895.81	4,743.68	242,894.50	0.00
000-28	0.00	1,613.20	10,883.83	3,587.76
000-16	-429.24	42,187.36	26,577.63	42,964.02
248	1,900.92	143,984.64	0.00	62,922.42
000-21	0.00	0.00	0.00	0.00
000-6B	-107.31	6,574.88	0.00	0.00
248-2	0.00	868,093.44	-698,254.30	247,692.06
000-14	124,096.35	0.00	0.00	0.00
000-24	0.00	148,553.92	98,391.74	99,797.94
000-26(MH)	0.00	23,936.40	0.00	0.00
063	1,195.74	5,188.40	38,222.19	20,748.42
202	878.92	0.00	32,819.21	24,027.30
071	1,778.28	146,626.80	71,424.76	9,266.40
000-17	0.00	18,948.56	22,833.88	19,946.52
000-18	112.42	30,528.72	13,866.85	11,030.58
000-30	3,658.76	0.00	0.00	0.00
000-30(1)	4,828.95	0.00	0.00	0.00
000-6A	-945.35	5,545.92	10,069.19	7,436.88
000-26(FH)	0.00	8,292.72	0.00	0.00
694-1	0.00	941.76	26,763.32	0.00
000-30(3)	2,856.49	0.00	0.00	0.00
449	935.13	54,936.00	0.00	0.00
422-1	0.00	4,909.36	0.00	0.00
000-31	12,775.00	6,784.16	8,619.61	4,086.72
000-30(2)	1,946.91	0.00	0.00	0.00
000-13	10,311.98	0.00	0.00	0.00
202-2	0.00	535,503.92	-532,924.31	57,457.62
000-9	0.00	4,133.28	1,629.28	0.00
TOTAL	167,689.76	3,498,237.28	245,637.92	1,551,135.96

PROJECT FUNDING DOCUMENTATION

RATED BY ESIR

HEILBRONN

PROJECT NO.	SIR	ESIR	COST	INCREMENT
ECO-000-10 (M.H.)	139.58	139.58	$16,484	G
ECO-000-12	81.60	81.60	$31,720	G
ECO-XXX-1	65.80	65.80	$89,800	G
ECO-000-10 (F.H)	59.65	59.65	$12,858	G
ECO-000-20 (F.H.)	37.53	37.53	$38,475	G
ECO-25-2	14.75	14.75	$ 260,860	B
ECO-000-20 (M.H.)	11.67	11.67	$852,700	B
EMC-694	7.70	7.70	$520,000	B
ECO-000-16	4.73	4.73	$407,000	B
EMC-248	4.58	4.58	$732,000	B
ECO-000-28	4.19	4.19	$65,100	B
ECO-000-26 (M.H.)	3.77	3.77	$90,300	B
ECO-000-24(MH)	3.28	3.28	$1,616,500	B
EMC-063	3.08	3.08	$275,000	B
EMC-202	2.98	2.98	$1,320,000	B
EMC-071	2.98	2.98	$247,000	B
ECO-000-24(FH)	2.68	2.68	$154,200	F
ECO-000-18	2.65	2.65	$215,926	B
ECO-000-30	2.60	2.60	$15,522	F
ECO-000-26 (F.H.)	1.98	1.98	$122,200	B
EMC-449	1.46	1.46	$342,000	B
ECO-000-13	1.20	1.20	$101,325	F

3.1 Section Overview

The total energy consumption at Heilbronn for base year 1975 was 799,117 Million BTU for all energy sources. The army facility's energy goal for 1985 is a reduction of 20% to 639,294 Million BTU from the 1975 base year. During 1982 Heilbronn used 815,566 Million BTU of energy for all sources. This is an increase of 2% from the base year of 1975. It is unlikely that this community will attain the reduction required to meet the army goal for 1985.

Included in Section 11 of the Phase II energy report is a detailed list of quick-fix items for each building in the community plus details of maintenance replacement items for each building in the community that will reduce energy consumption. It is recommended that a concerted effort be made by the community to attend to all the items listed. If all of the quick-fix items are accomplished and better SOP's developed for the community then the energy used in 1985 should at least be below that of fiscal year 1975.

Projection to the year 2000, the army facility's energy plan calls for another 20% reduction from the base year 1975 to 479,470 Million BTU from all sources. If the ECO's described in this report are implemented this goal is attainable.

3.2 Interaction of ECO's by GY Area

The reason for ranking the ECO's by SIR is to implement those at the top of the list first so that the greatest possible energy savings can be accomplished for the available capital. However, as measures at the top of the list are accomplished it dilutes the savings of those items further down the list of interaction occurs. As a result those items which have an SIR of near one (1) at the beginning of an energy conservation program will probably not be cost effective after measures further up the list are accomplished.

However, at this community many of the boiler plants are past their useful life and should be replaced. Most of the smaller boilers are only 45% efficient and should be replaced with either central coal plants

which will improve the efficiency to 65% resulting in savings of 20% or central oil fired plants which will improve the efficiency to 75% resulting in savings of 30%.

It is obvious, of course, that the SIR of the replacement boilers will be less than the SIR of the insulation upgrading or improving the building heating controls, especially when they are based upon the lower boiler efficiency.

There are numerous ways in which energy conservation measures interact and many combinations of interactions between measures. However, the quick fix low cost approach of improving the building envelopes by insulation, upgrading building heating controls and improving the distribution system will not provide the full amount of savings stated with the boilers in their present inefficient condition.

It is, therefore, recommended that, where possible, the boilers should be replaced or boiler plants consolidated into district heating systems.

With this strategy in mind, the ECO's have been interacted to show the possible savings.

The following is a list of recommended ECO's by GY area after interaction has taken place.

GY 063 Artillery Kaserne

Boiler Plants

Most of the boiler plants can be made more efficient either by replacing boilers or by improving the insulation efficiency of all ancillary components. The following ECO effects the boiler plants directly and should be accomplished during the summer months due to shutdown requirements:

063-1 New Boilers and Insulation

Note: This ECO is on hold pending negotiation of District heat.

Domestic Hot Water

ECO's 10 and 12 should be accomplished next since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-25 Steam Trap Replacement
000-24 Piping Insulation

It is imperative that these three (3) ECO's be accomplished as soon as possible as they represent 70% of the total possible savings in this GY area.

Building ECO's

The following ECO's affect the buildings in the community and should be accomplished at the same time:

000-2 Reschedule Building Heat Use, As an ECO, this has not been carried to a request for funding. The EMCS Program is recommended which will accomplish the same goal more effectively.
000-18 Weatherstripping

All the above ECO's are effected by improvements made to the boiler plants and therefore energy savings will be reduced by 6%.

Process Systems

ECO-000-6A describes the heat recovery possible by preheating mess hall make-up air units with exhaust heat. This ECO should not be accomplished. ECO-000-6B concerns energy conservation from laundries and refrigeration equipment. Only the recovery from refrigeration equipment is recommended for consideration.

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings:

000-14 Relamping of Interior Lights
000-31 Electrical Metering, This measure actually saves no energy but it will provide the tool to pinpoint over use.
000-13 Relamping of Exterior Lights
Fossil Fuel: These ECO's will effect fuel consumption
000-16 Spot Heating
000-28 Boiler Blowdown Heat Recovery

These measures can be accomplished at any time and do not interact with any other measure.

ECO's Not Recommended After Interaction

000-6A Pre-heating make-up air
000-9 Hotwater
000-17 Attic Insulation
000-31 Metering Heating Systems

GY 071 Badenerhof

Boiler Plants

Major renovations are required to the boiler plants in this community. Almost 50% of the installed capacity should be replaced. The following ECO's affect the boiler plants directly.

071-2 Provides heat from Building 301 and shutdown coal boilers in building 316.

000-28 Boiler blowdown heat recovery.

These ECO's will have a dramatic affect on improving the boiler efficiencies and reducing energy consumption by as much as 40%. However, once implemented, they will affect the savings of all other measures by reducing them by 42%. These ECO's will need executed during the summer months.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-25 Steam Trap Replacement
000-24 Piping Insulation

As a result of the change to different boiler plants savings will be reduced approximately 42%.

Domestic Hot Water

ECO's 10 and 12 should be accomplished next since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Building ECO's

The following ECO's affect the buildings in the community and should be accomplished at the same time:

000-2 Reschedule Building Use: With the EMCS systems being recommended this ECO can be accomplished more effectively by the EMCS.
000-18 Weatherstripping

Process Systems

ECO-000-6A describes the heat recovery possible by preheating mess hall make-up air units with exhaust heat. This project no longer provides a positive SIR.

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings:

000-14 Relamping of Interior Lights
000-31 Electrical Metering
000-13 Relamping of Exterior Lights

These three measures can be accomplished at any time and do not interact with any other measure.

ECO's Not Recommended After Interaction

071-1 Improvements to Existing Power Plants
000-17 Attic Insulation
000-31 Metering Heating Systems
Recommended:
000-16 Spot Heating

GY 202 Kennedy Housing

Boiler Plants

Most of the boiler plants require attention either by replacing boilers and burners or by improving the insulation of all ancillary components. Some of the boilers are about 30 years old and are in poor condition. Further, there are numerous relatively new small plants throughout the community.

ECO-202-2 recommends one power plant for the whole community with an SIR of 1.10. It is recommended that this ECO be implemented first as it will result in both energy and manpower savings. It must be noted that most of the small oil fired boilers are reasonably new, we would suggest that they be relocated and used to replace similar sized coal fired boilers in other GY areas. It must also be noted that the sizing of the new plant has been based upon present conditions. If all ECO's are implemented, the design load will reduce and lower the cost of installed equipment and increase the SIR. With the potential of district heat pending, this ECO should be on "hold" status.

Domestic Hot Water

ECO's 10 and 12 should be accomplished next since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Savings will now be residual fuel as a result of ECO 202-2.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-24 Piping Insulation

It is imperative that these two (2) ECO's be accomplished as soon as possible as they will reduce the capacity requirements for the new boiler plant, or for district heat.

Building ECO's

The following ECO affects the buildings in the community and should be accomplished:

000-18 Weatherstripping

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings:

000-14 Relamping of Interior Lights
000-31 Electrical Metering - see previous comments
000-13 Relamping of Exterior Lights

These measures can be accomplished at any time and do not interact with any other measure.

ECO's Not Recommended After Interaction

202-1 Improvements to Small Boilers Now Not Operational
000-31 Metering Heating Systems

GY 204, GY 248 Dolan Barracks

Boiler Plants

Most of the boilers in this Kaserne are over thirty (30) years old and are in need of replacement. A few of the boilers are new and can be relocated to other Kasernes and used to replace older coal fired boilers.

ECO 248-2 recommends building a central residual oil fired plant and expanding the distribution system to service other buildings which have older boilers. Again, the first cost of this ECO was developed using current energy use. If all ECO's are implemented, the peak loss will decrease allowing for smaller boilers to be put in the central plant hence lowering the cost and increasing the SIR. Implementation of this ECO will reduce the savings of other ECO's which are related to the coal plant by 40%. Distillate savings will remain similar, however, a corresponding amount of residual

fuel will be saved instead. This ECO is not completed to request for funding pending the outcome of district heat.

Domestic Hot Water

ECO's 10 and 12 should be accomplished next since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-25 Steam Trap Replacement
000-24 Piping Insulation

It is imperative that these three (3) ECO's be accomplished as soon as possible as they represent 53% of the total possible fossil fuel savings in this GY area.

Building ECO's

The following ECO's affect the buildings in the community and should be accomplished at the same time:

000-2 Reschedule Building Heat Use - this ECO is more effectively accomplished thru the EMCS System (EMC-248)
000-18 Weatherstripping

The above ECO's are affected by improvements made to the boiler plants and therefore energy savings will be reduced by 40%.

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings:

000-14 Relamping of Interior Lights
000-31 Electric Metering - see previous comments
000-13 Relamping of Exterior Lights

These measures can be accomplished at any time and do not interact with any other measure.

ECO's Not Recommended After Interaction

248-1 Improvements to Small Boilers
000-28 Boiler Blowdown Heat Recovery
000-16 Spot Heating

GY 422 Dallau

GY-442 Dallau has been deleted from the overall systematic energy reduction plan because it is currently an inactive installation and no longer considered a part of the Heilbronn Military Community. The results of our Phase I and Phase II work pertaining to GY-422 is presented herein to document the suggested changes in this GY area if the area was in active use.

Section 4 entitled "Conclusions" has been revised to delete this GY area and, hence, reflects no energy consumption nor energy savings for the area.

Boiler Plants

Most of the boiler plants require attention either by replacing boilers and burners or by improving the insulation standards of all ancillary components. The following ECO's effect the boiler plants directly and should be accomplished during the summer months due to shutdown requirements:

422-2 Expand Boilers in Bldg. 4053
422-1 New Boilers, Burners and Insulation (Partial only)

Since the implementation of these two measures affect the operating performance of the boiler plants, the savings for all other ECO's will be reduced by 6%.

Domestic Hot Water

ECO's 10 and 12 should be accomplished first since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-24 Piping Insulation
000-25 Steam Trap Replacement

It is imperative that these three (3) ECO's be accomplished as soon as possible as they represent 54% of the total possible distillate fuel savings in this GY area.

Building ECO

The following ECO affects the buildings in the community and should be accomplished at the same time:

000-17 Attic Insulation

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings:

000-13 Relamping of Exterior Lights
000-14 Relamping of Interior Lights
000-30 Street Lighting Improvements
000-31 Electric Metering

These four measures can be accomplished at any time and do not interact with any other measure.

ECO's Not Recommended After Interaction

422-1 Improve Boiler Plant (to be shutdown)
000-16 Spot Heating

Note: These results are not included in Table 4 of Section 4 - "Conclusions".

GY 449 Siegelsbach

Domestic Hot Water

ECO's 10 and 12 should be accomplished first since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Boiler Plant

The small distillate oil-fired boilers throughout the community need attention. The following ECO should be implemented:

499-1 Boiler Improvements.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-25 Steam Trap Replacement
000-24 Piping Insulation

It is imperative that these three (3) ECO's be accomplished as soon as possible as they represent 68% of the total possible distillate savings in this GY area.

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings and can be accomplished at any time and do not interact with any other measure:

000-13 Relamping of Exterior Lights
000-14 Relamping of Interior Lights
000-30 Street Lighting Improvements
000-31 Electric Metering

000-16 Spot Heating: This measure can be accomplished any time however summer time will cause less inconvenience to the users.

GY 638 Heilbronn Training

Domestic Hot Water

ECO's 10 and 12 should be accomplished first since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Boiler Plants

The small distillate oil-fired boilers throughout the community need attention. The following ECO should be implemented:

638-1 Boiler Cleaning and Insulation

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-24 Piping Insulation
000-25 Steam Trap Replacement

It is imperative that these three (3) ECO's be accomplished as soon as possible as they represent 56% of the total possible savings in this GY area.

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings and can be accomplished at any time and do not interact with any other measure.

000-14 Relamping of Interior Lights
000-31 Electric Metering
000-13 Relamping of Exterior Lights
000-30(3) Improve Street Lighting

000-16 Spot Heating: This measure can be accomplished any time, however summer time will cause less inconvenience to the users.

GY 694 Wharton Barracks

Boiler Plants

Most of the boiler plants require attention either by replacing boilers and burners or by improving the insulation standards of all ancillary components. The following ECO effects the boiler plants directly and should be accomplished during the summer months due to shutdown requirements.

694-1 New Boilers, Burners and Insulation

Since the implementation of this measure will affect the operating performance of the boiler plants, savings for all other ECO's were reduced by 8%.

Domestic Hot Water

ECO's 10 and 12 should be accomplished first since they each have high SIR's and deal strictly with domestic hot water. However, the implementation of ECO 10 will reduce the effectiveness of ECO 12 by 25%.

Distribution Systems

The following ECO's should be done as a group during the summer months as they would require the shutdown of the heating systems:

000-20 Building Heating Controls
000-25 Steam Trap Replacement
000-24 Piping Insulation

It is imperative that these three (3) ECO's be accomplished as soon as possible as they represent 72% of the total possible fossil fuel savings in this GY area.

Building ECO's

The following ECO's affect the buildings in the community and should be accomplished at the same time:

000-2 Reschedule Building Heat Use, by EMCS
000-18 Weatherstripping

Process Systems

ECO-000-6B describes the heat recovery possibility recovering energy from refrigeration equipment. This ECO could be accomplished at any time.

Electrical Systems

The following ECO's affect the electrical energy consumption of the buildings and can be accomplished at any time and do not interact with any other measure.

000-14 Relamping of Interior Lights
000-13 Relamping of Exterior Lights
000-31 Electric Metering

These measures can be accomplished anytime, however 00028 should be done during the summer to eliminate boiler shut down in the winter.

000-6b Heat Recovery from Refrig. Equipment
000-28 Boiler Blowdown
000-16 Spot Heating

Section 4.0 Conclusions

4.1 Energy Reduction after Plan Implementation

If the systematic plan as outlined in the previous section is followed, the community will save 12% and 54% of the electrical and fossil fuel consumptions respectively. Overall, the reduction represents 41% of the 1982 total energy consumed. Although the fossil fuel savings appear high, it must be remembered that many of the boilers are only 45% efficient, distribution systems are poorly insulated, and building heating controls are non-existant.

If the plan as outlined is implemented, it will require a capital cost of $7,527,000 and produce an annual savings of $2,230,727 giving a simple payback in 3.37 years. These figures do not reflect consumption, savings, or capital costs for projects in GY-442, Dallau because it is presently inactive.

The following table (Table 4) shows a breakdown of energy in Million BTU used by GY area for fiscal year 1982 and the savings achievable if the plan as outlined is implemented.

HEILBRONN MILITARY COMMUNITY

TABLE 4 BELOW INDICATES ENERGY CONSUMPTION, ENERGY SAVED AND PERCENT SAVED
FOR FUEL TYPES AFTER THE SYSTEMATIC ENERGY REDUCTION PLAN IS IMPLEMENTED

TABLE 4

MILLION BTU

GY AREA	ELECT CONSUM	ELECT SAVED	% SAVED	DISTI CONSUM	DISTI SAVED	% SAVED	RESI CONSUM	RESI SAVED	% SAVED	COAL CONSUM	COAL SAVED	% SAVED
063	18,666	776.	4.2	3,010	1,184.	39.3	28,212	-20,160.	-71.5	24,893	14,271.	57.3
071	14,790	759.	5.1	0	0.	0.0	25,757	-6,973.	-27.1	20,269	14,866.	73.3
202	65,868	14,101.	21.4	61,411	41,337.	67.3	40,868	151,207.	370.0	9,673	7,095.	73.3
248	47,711	7,485.	15.7	99,552	67,010.	67.3	0	91,543.	0.0	41,699	30,583.	73.3
449	16,446	1,096.	6.7	28,419	8,533.	30.0	0	0.	0.0	0	0.	0.0
638	22,970	1,194.	5.2	12,350	3,447.	27.9	0	0.	0.0	0	0.	0.0
694	55,340	3,548.	6.4	2,148	1,020.	47.5	138,436	-112,546.	-81.3	0	0.	0.0
TOTAL	241,791	28,959.	12.0	206,890	122,531.	59.2	233,273	103,071.	44.2	96,534	66,815.	69.2

TOTAL FOSSAL FUEL CONSUMPTION	536,697
TOTAL FOSSAL FUEL SAVED	292,417.
TOTAL ELECTRICITY CONSUMPTION	241,791
TOTAL ELECTRICITY SAVED	28,959.

5.1 Section Overview

This section discusses the geography, climate, history, population and planned changes for the community. Each topic is separated into a sub-section for clarity.

5.2 Geographic Location

The area is located in the West German state of Baden-Wurttemberg. The major installations are near the city of Heilbronn with an approximate population of 113,000 people. The area is primarily industrial with light farming. Most of the agricultural activity is in wine production. For the most part the various Kasernes are generally about 400 meters square, except areas with training areas and launch sites.

The general location of the Heilbronn Community is 49° latitude and 9° longitude. The general elevation is 558 feet or 170 meters above sea level. Badenerhof Kaserne, Kennedy Family Housing and Wharton Barracks are integral with the city of Heilbronn. The Artillery Kaserne is northeast of Heilbronn approximately 3-3/4 miles or 6 kilometers. Dolan Barracks is located near Schwaebisch Hall which is 34 miles or 54 kilometers southeast of Heilbronn. Heilbronn Training Area is southeast of the city 3-1/4 miles or 5.2 kilometers. Hessental is southeast of Heilbronn approximately 33-1/2 miles or 54 kilometers. Dallau and Siegelsbach are northwest of Heilbronn approximately 24 miles or 38 kilometers and 17 miles or 27 kilometers, respectively. Currently, Dallau is inactive.

Paragraph 5.7 included in this section includes a site map showing the general locations.

5.3 Climate and Design Conditions

5.3.1 The outdoor design condition in winter for the area is +11°F. from the 97-1/2% weather data column. The extreme winter outdoor temperature is around 0°F. with a prevailing wind from the northeast at approximately 6 knots. The area experiences approximately 5750 degree days. The summer temperatures are generally mild.

The maximum temperature observed is ordinarily 84°F. with a normal high reading 80°F. or less. This weather summary is interpolated from the Department of the Army Technical Manual- TM 5-785 entitled Engineering Weather Data. Air conditioning in summer is normally not required.

5.3.2 Indoor Design Conditions

Allowable temperatures by Army regulation are 65°F in winter for housing, dormitories and administrative areas, and 55°F for shops and other work areas. No requirements are set for warehousing and storage except as required for proper safekeeping of stored material. All building heat must be shut off when the outdoor ambient temperature is above 60°F. It can be restored only after 48 hours continuously below 60°F.

5.4 History

The Heilbronn community is primarily of pre-World War I and pre-World War II vintage. Wall construction is masonry, with, in most cases, tile or slate roof systems. The major buildings are structurally sound and are considered as permanent. The family housing areas, for the most part, have been constructed since World War II. The housing, constructed by the United States since World War II, is of two basic plans. The material of construction is masonry with stucco on the exterior. Modernizing for energy efficiency is being accomplished by added external insulation and new stucco.

The preservation of old German architecture has been maintained in most areas as the German Government monitors and approves modifications to the buildings. Many of the buildings are classified as historical structures, and changes are usually prohibited.

The U.S. Government has had possession of the facilities since the end of World War II. However, the agreement did not lend itself to the capital investment by the U.S. for massive improvements. For this reason, many buildings need substantial improvements. The Energy Conservation Officer at Heilbronn stated that our government had only a year-by-year agreement with West Germany. Within the past few years, a thirty year

agreement was obtained. Since the new agreement, much repair has been accomplished. These repairs have consisted of adding new windows and exterior insulation to family housing units and new windows, doors, and roof systems to some administrative buildings.

The current military occupancy in the Heilbronn community is track-type armored vehicles, helicopter-type craft, and their support units.

5.5 Population

5.5.1 The population of the Heilbronn military was obtained for fiscal year 1975 through fiscal year 1982. The base population of active duty personnel and dependents was approximately 9,500 in FY-1975. A minor escalation was experienced in 1980 to approximately 10,000 people. The population then remained relatively stable thru 1982 and is projected to remain stable from FY-82 thru FY-85.

An illustrative curve for Heilbronn population is included in paragraph 5.7 of this section.

5.6 Building Summary

The Heilbronn Military Community consists of the following GY areas:

GY Area	Name	Sq. Feet Heated Area	No. of Buildings	No. of Models
063	Artillery Kaserne	401,281	22	3
071	Badenerhof Kaserne	342,720	19	2
202	Kennedy Family Housing	1,372,971	45	4
248	Dolan Barracks	998,299*	73	7
449	Siegelsbach Ammo Facility	128,494	38	2
638	Heilbronn Training Area	72,192	16	2
694	Wharton Barracks	1,014,797	47	4
	Totals	4,331,474	260	24

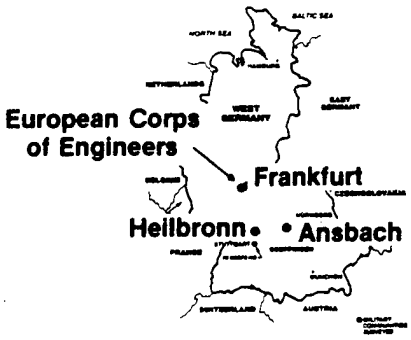
*Includes Hessental Family Housing

NOTE Above listing excludes GY-422, Dallau tactical defense station which has been deactivated.

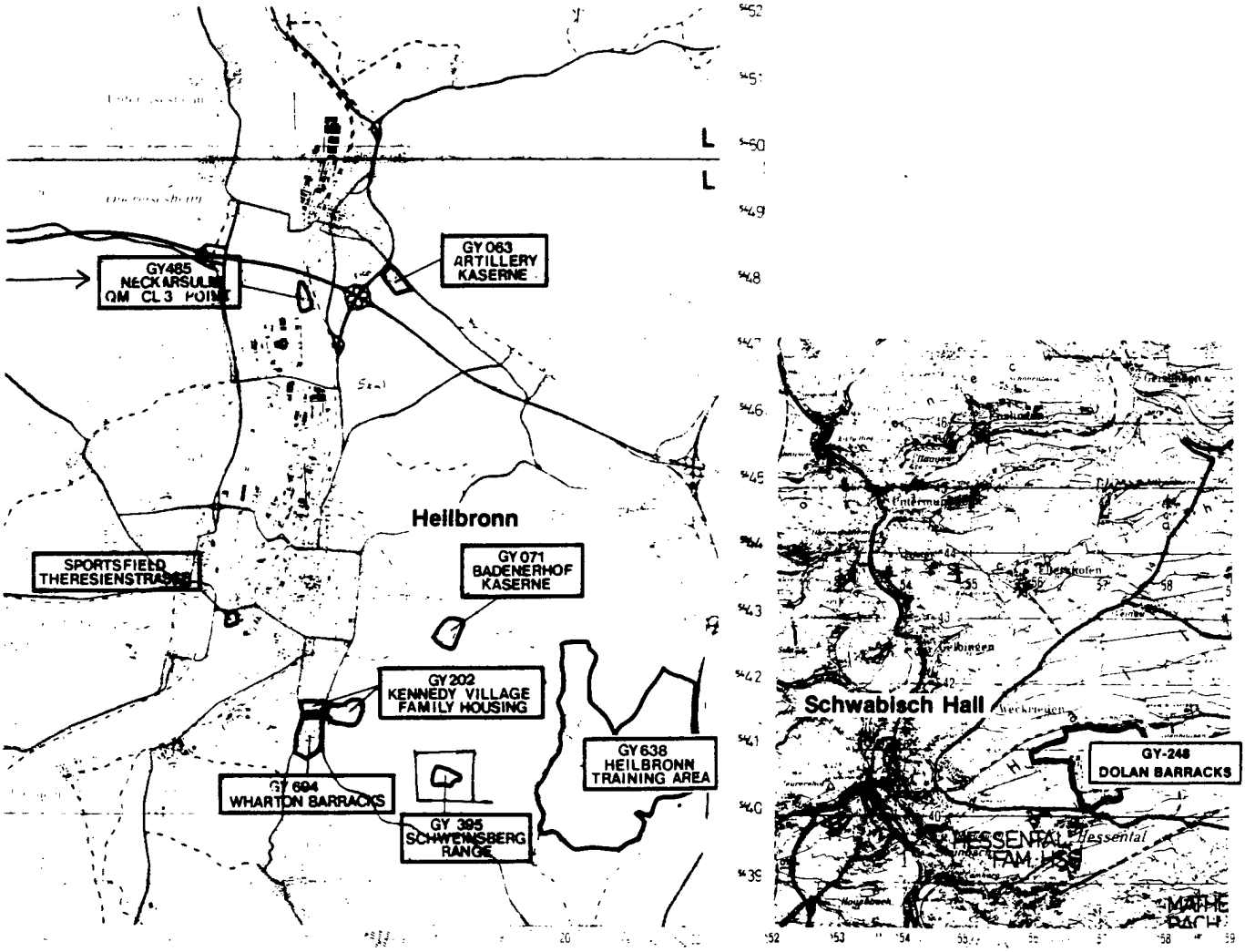
A complete list of all buildings in the Heilbronn Military Community as well as data required for the energy engineering analysis as obtained by the Phase I survey is contained in Volume II, Appendix B, of the Phase II submittal.

5.7 Illustrations and Support Material

Heilbronn Community



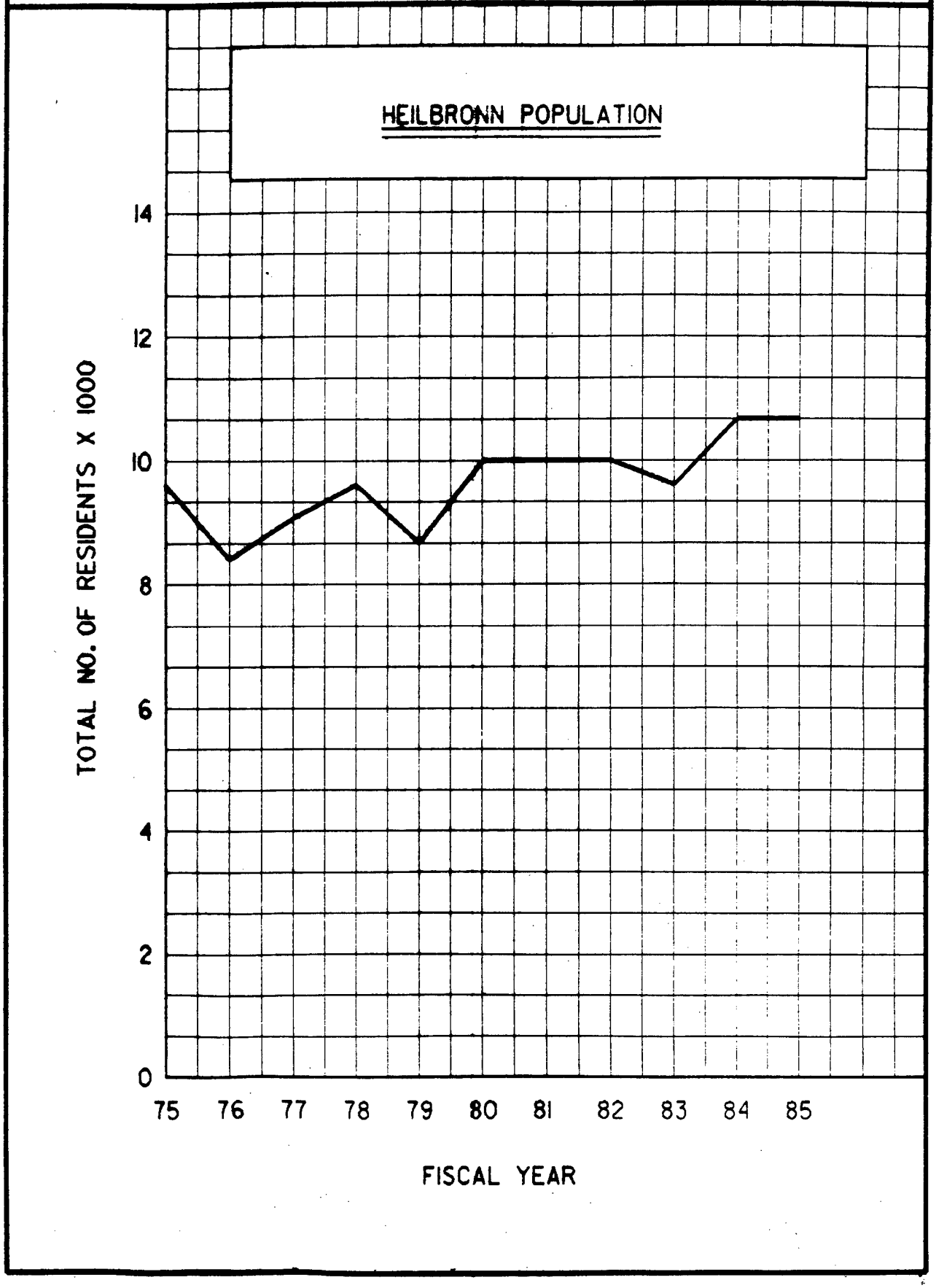
Wharton Barracks GY-694
Kennedy Village Family Housing GY-202
Badenerhof Kaserne GY-071
Dolan Barracks GY-248
Artillery Kaserne GY-063
Heilbronn Training Area GY-638
Siegelsbach Ammo Facility GY-449
Dallau Air Defense GY-422
Hessental Family Housing GY-204



CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY



6.1 Section Overview

This section is a summary of energy consumption records for fiscal year 1975 through fiscal year 1982.

The base line from which the energy goals will be measured is year 1975. Chart 6-1 indicates the energy used by fuel type and the total energy consumed for this period.

The year 1982 is used to establish the current base line applied to the computer modeling output.

6.2 Electrical Consumption

6.2.1 The consumption of electricity for FY-1975 through FY-1982 is as follows:

1975	19,120,142 KWH
1976	20,590,763 KWH
1977	21,954,022 KWH
1978	20,244,472 KWH
1979	20,526,641 KWH
1980	21,690,972 KWH
1981	22,026,424 KWH
1982	22,969,250 KWH

Refer to Chart 6-2 for the graphic illustration of this consumption.

6.3 Fossil Fuel Consumption

6.3.1 Coal

The consumption of coal for FY-1975 through FY-1982 is as follows:

1975	117,300,764 KBTU
1976	99,115,272 KBTU
1977	100,400,610 KBTU
1978	104,574,441 KBTU
1979	98,471,517 KBTU
1980	93,638,219 KBTU
1981	94,398,535 KBTU
1982	97,532,666 KBTU

Refer to Chart 6-3 for the graphic illustration of this consumption.

6.3.2 Fuel Oil No. 2

The consumption of No. 2 fuel oil for FY-1975 through FY-1982 is as follows:

1975	196,909,061 KBTU
1976	181,922,804 KBTU
1977	179,822,608 KBTU
1978	189,249,215 KBTU
1979	193,215,896 KBTU
1980	191,977,998 KBTU
1981	190,000,553 KBTU
1982	218,316,202 KBTU

Refer to Chart 6-4 for the graphic illustration of this consumption.

6.3.3 Fuel Oil No. 6

The consumption of No. 6 fuel oil for FY-1975 to FY-1982 is as follows:

1975	263,113,976 KBTU
1976	266,619,552 KBTU
1977	254,636,480 KBTU
1978	263,262,176 KBTU
1979	260,931,256 KBTU
1980	225,855,888 KBTU
1981	238,873,320 KBTU
1982	233,273,000 KBTU

Refer to Chart 6-5 for a graphic illustration of this consumption.

6.4 Baseline FY-1975 Energy Consumption

The Heilbronn Military Community contains 4,387,319 square feet of heated building area. The total fossil fuel energy consumption for the community during the baseline 1975 fiscal year was as follows:

Coal	117,300,764 KBTU
Fuel Oil No. 2	196,909,061 KBTU
Fuel Oil No. 6	263,113,976 KBTU
Total	577,323,801 KBTU

This equates to 131.6 KBTU per square foot of building area for the baseline 1975 fiscal year.

The total electrical consumption for the 1975 fiscal baseline year for the community was 19,120,142 KWH, including exterior uses such as street lighting, pumps, water plants, etc. This yields 4.38 KWH per square foot of building for the baseline 1975 fiscal year.

The total energy consumption for base year 1975 was 799,117,451 KBTU for all energy sources. The Army facility's energy goal for 1985 is a reduction of 20% to 639,293,945 KBTU from the 1975 base year. The fiscal year 2000 energy goal is a further reduction of 20% to 479,470,459 KBTU.

6.5 Fiscal Year 1982 Energy Consumption

The historical energy data chart indicates the fossil fuel, electrical energy and total energy by million BTU used in each GY area for 1982.

Also included in this chart is the percent of the total fossil fuel, percent of the total electrical energy and percent total of all energy used throughout the comunity.

The total fossil fuel energy consumption for 1982 was as follows:

Coal	97,532,666 KBTU
Fuel Oil No. 2	218,316,202 KBTU
Fuel Oil No. 6	233,273,000 KBTU
Total	549,121,868 KBTU

This equates to 126 KBTU per square foot of building area during 1982.

The total electrical consumption for fiscal year 1982 was 22,969,250 KWH. This equates to 5.24 KWH per square foot of building area.

The monthly consumption of fuel type for 1982 is shown on Charts 6-6 thru 6-9.

Charts 6-10 thru 6-14 reflect the energy uses by type and building use.

As previously mentioned the total energy consumption for ECO base year 1982 was 815,565,168 KBTU. This is an increase of 2.06 percent from the base year 1975. If all the quick fix items discussed during the exit interview and included in Section 11 of the Phase II Energy Report are accomplished, then the 1985 goal of a 20% reduction should be attainable.

HISTORICAL ENERGY DATA (FISCAL YEAR 1982)

AREA	FOSSIL FUELS MBTU	% TOTAL FOSSIL FUEL	ELECTRIC ENERGY MBTU	% TOTAL ELEC.	TOTAL ENERGY MMBTU	% TOTAL ENERGY
GY-063 ARTILLERY KASERNE	56,115	10.21	18,666	7.01	74,781	9.17
GY-071 BADENERHOF KASERNE	46,026	8.38	14,790	5.55	60,816	7.46
GY-202 KENNEDY FAMILY HOUSING	111,952	20.39	65,868	24.72	177,820	21.81
GY-204 HESSENTAL FAMILY HOUSING	INCLUDED IN GY-248 (DOLAN BARRACKS)					
GY-248 DOLAN BARRACKS	143,251	26.09	47,711	17.91	190,962	23.41
GY-422 ** DALLAU	11,426	2.08	24,652	9.25	36,078	4.42
GY-449 SIEGELSBACH AMMO	28,419	5.18	16,446	6.17	44,865	5.50
GY-638 HEILBRONN TRAINING	12,350	2.25	22,970	8.62	35,320	4.33
GY-694 WHARTON BARRACKS	139,584	25.42	55,340	20.77	194,924	23.90
TOTALS	549,123	100%	266,443	100	815,566	100%

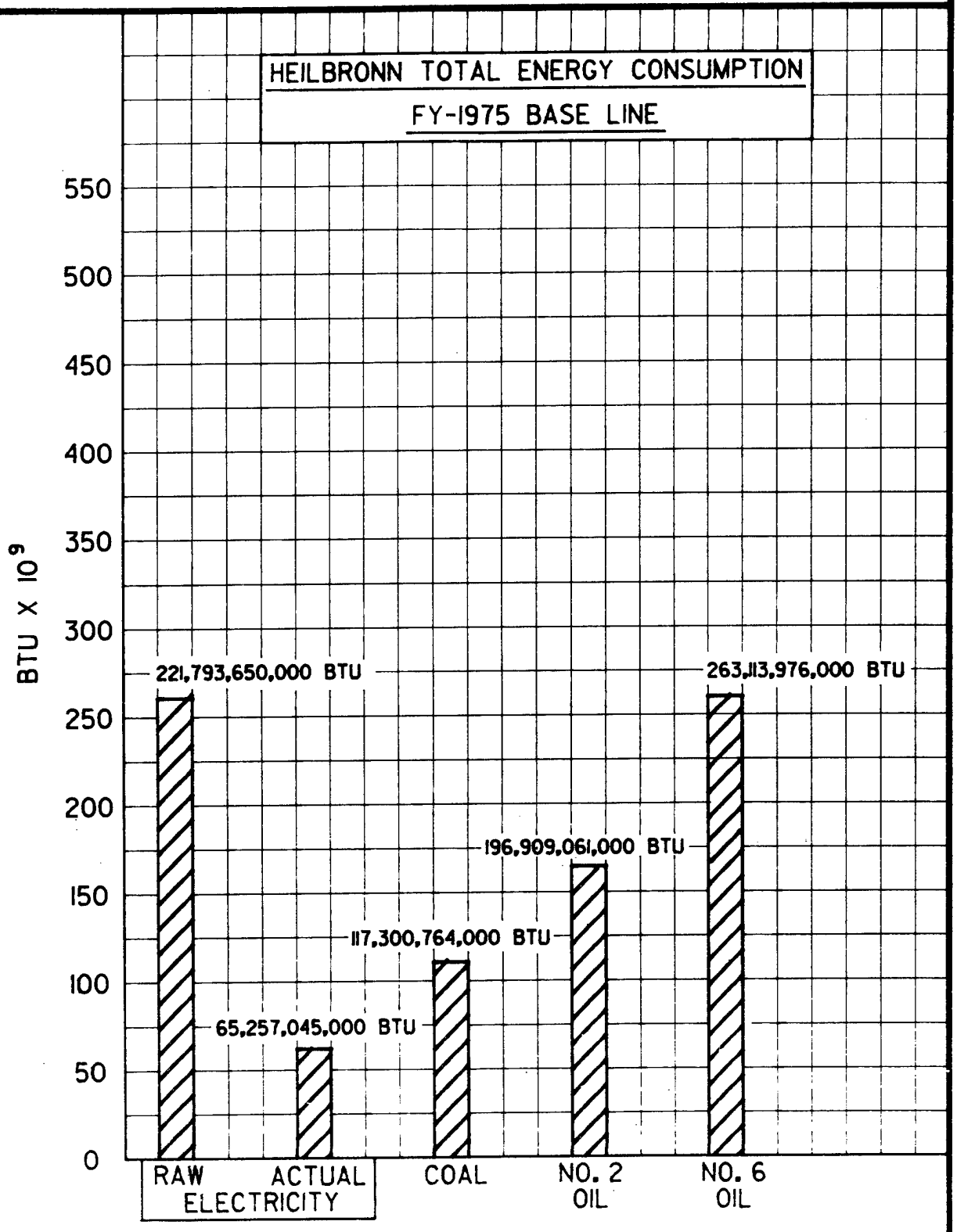
** Included for record purposes only. This installation is currently inactive.

6.6 Illustrations and Support Materials

CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY



RAW ELECTRICITY ENERGY IS BASED ON 11,600 BTU PER KILOWATT AT POINT OF GENERATION

TOTAL CONSUMED ENERGY FY-1975 642,580,846,000 BTU

TOTAL RAW ENERGY FY-1975 799,117,451,000 BTU

Chart 6-1

CORPS OF ENGINEERS

EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

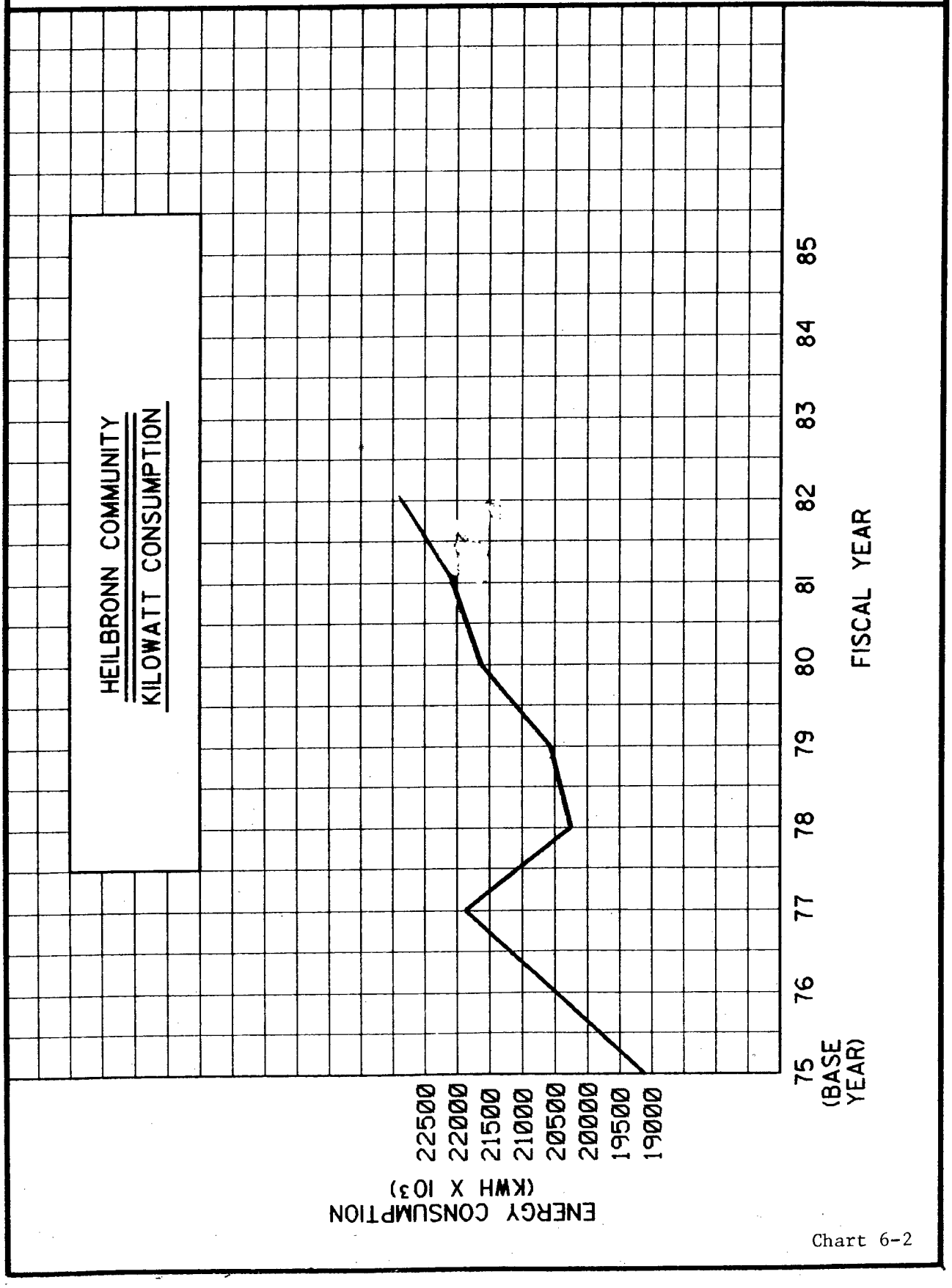


Chart 6-2

CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

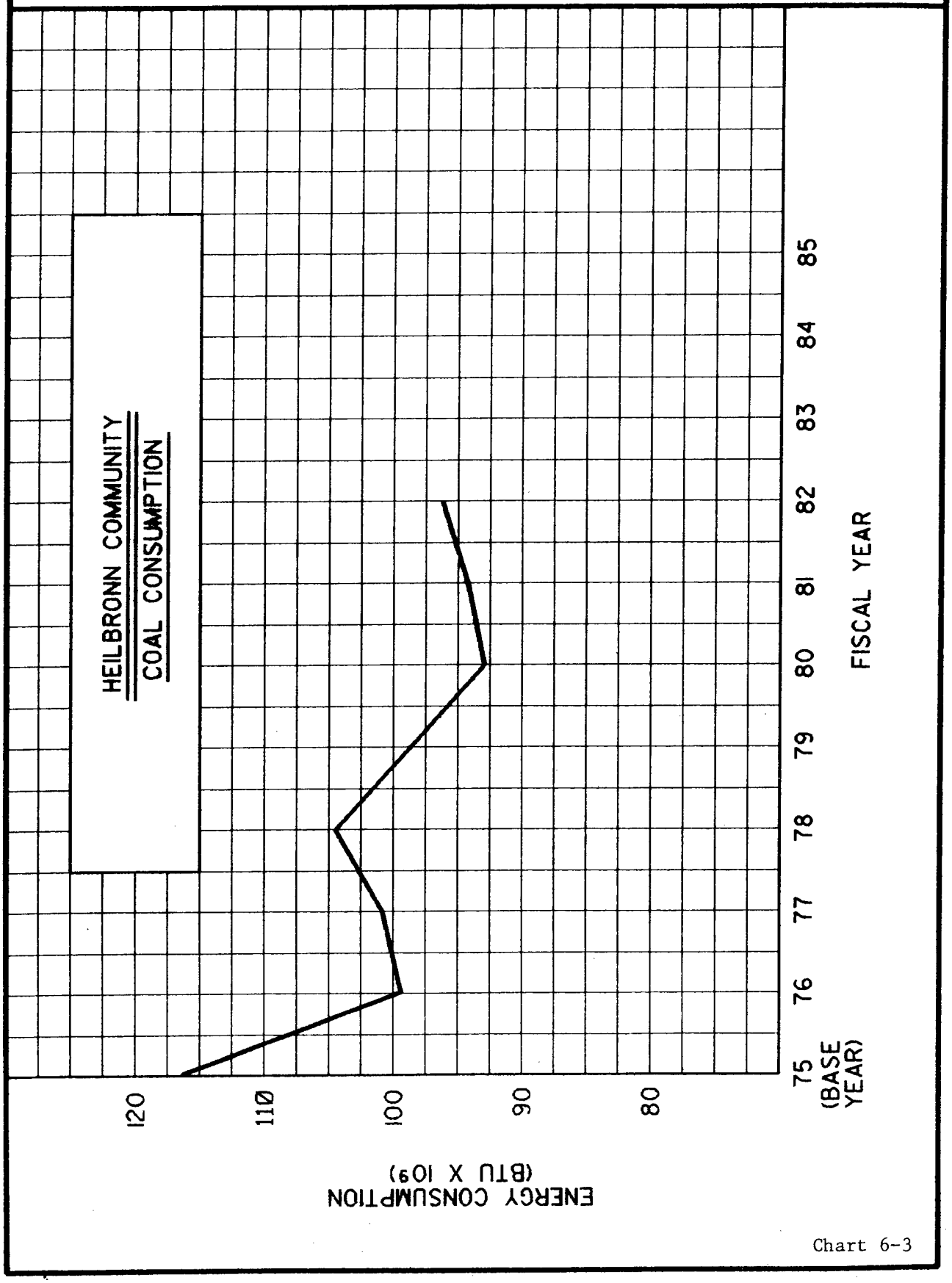


Chart 6-3

CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

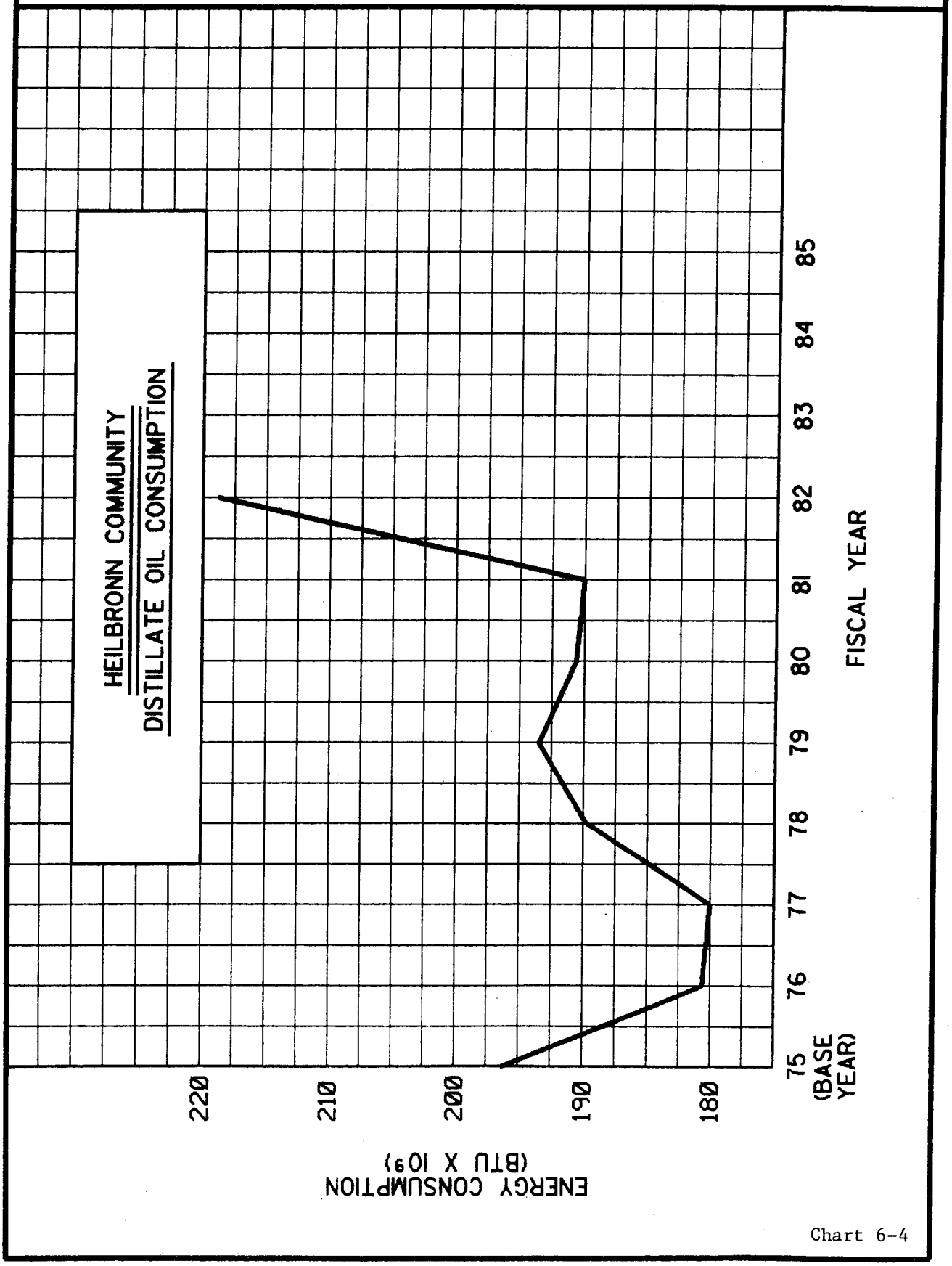


Chart 6-4

CORPS OF ENGINEERS EUROPE DIVISION

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HEILBRONN MILITARY COMMUNITY

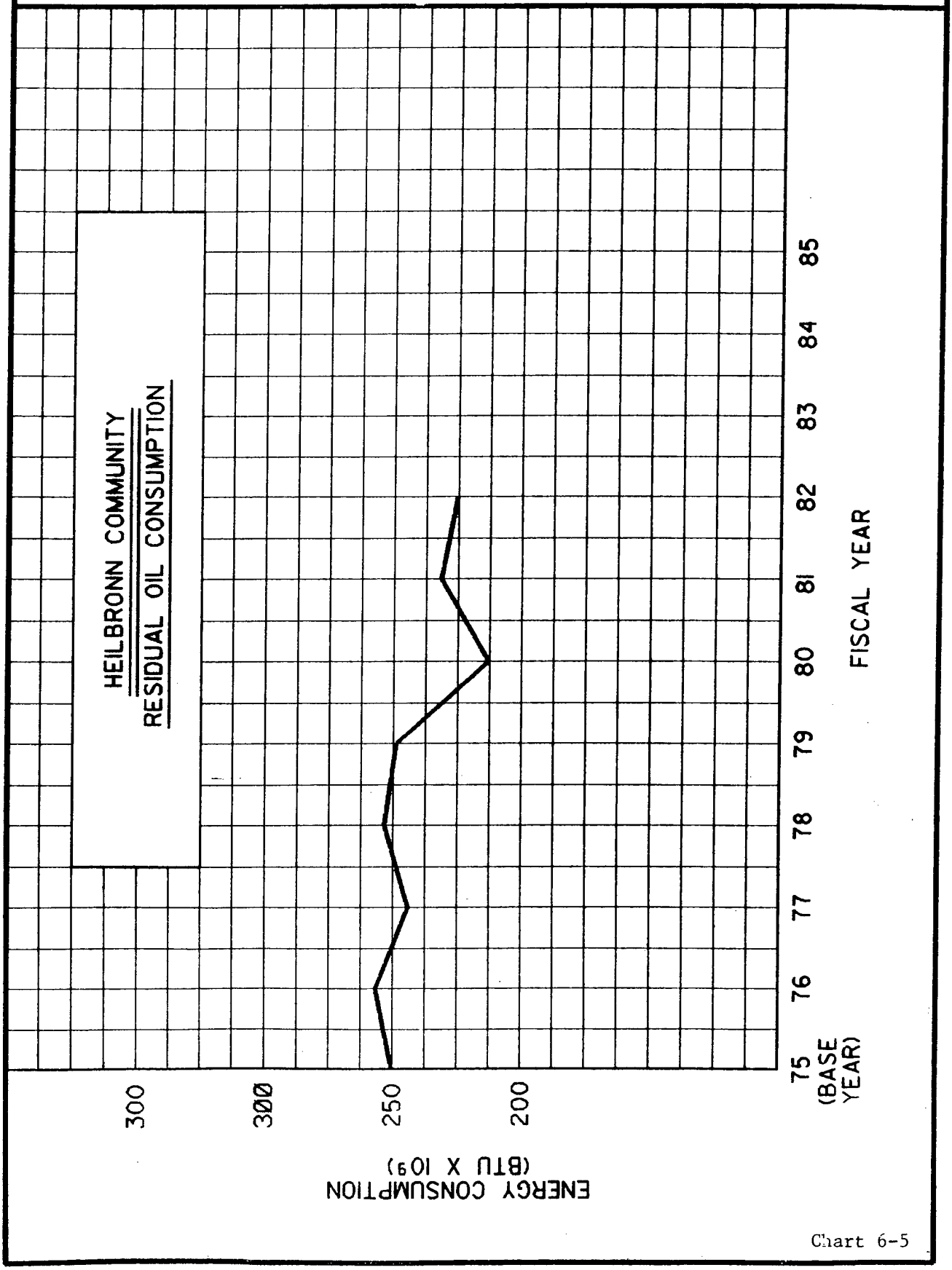

Chart 6-5

CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

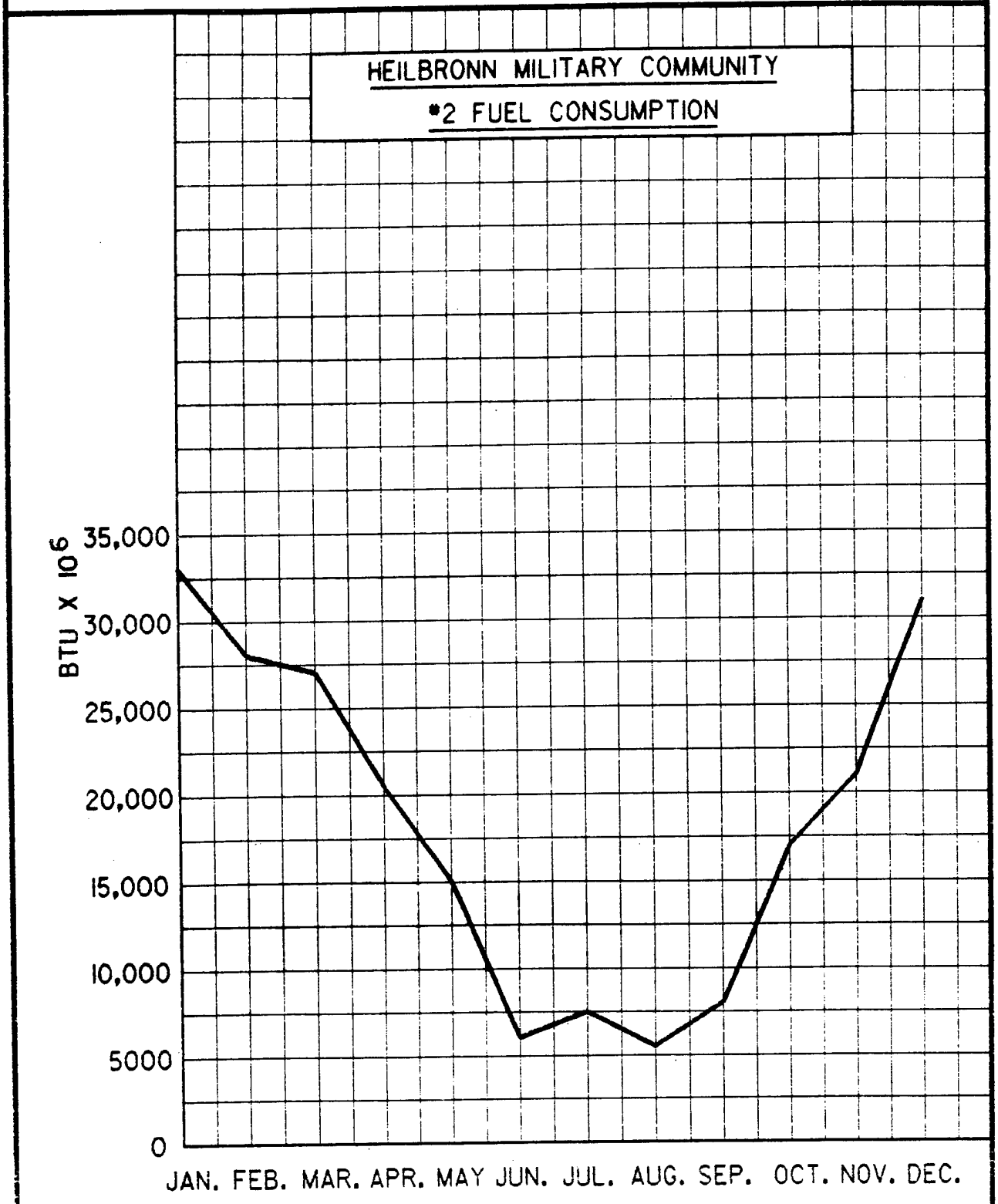

Chart 6-6

CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

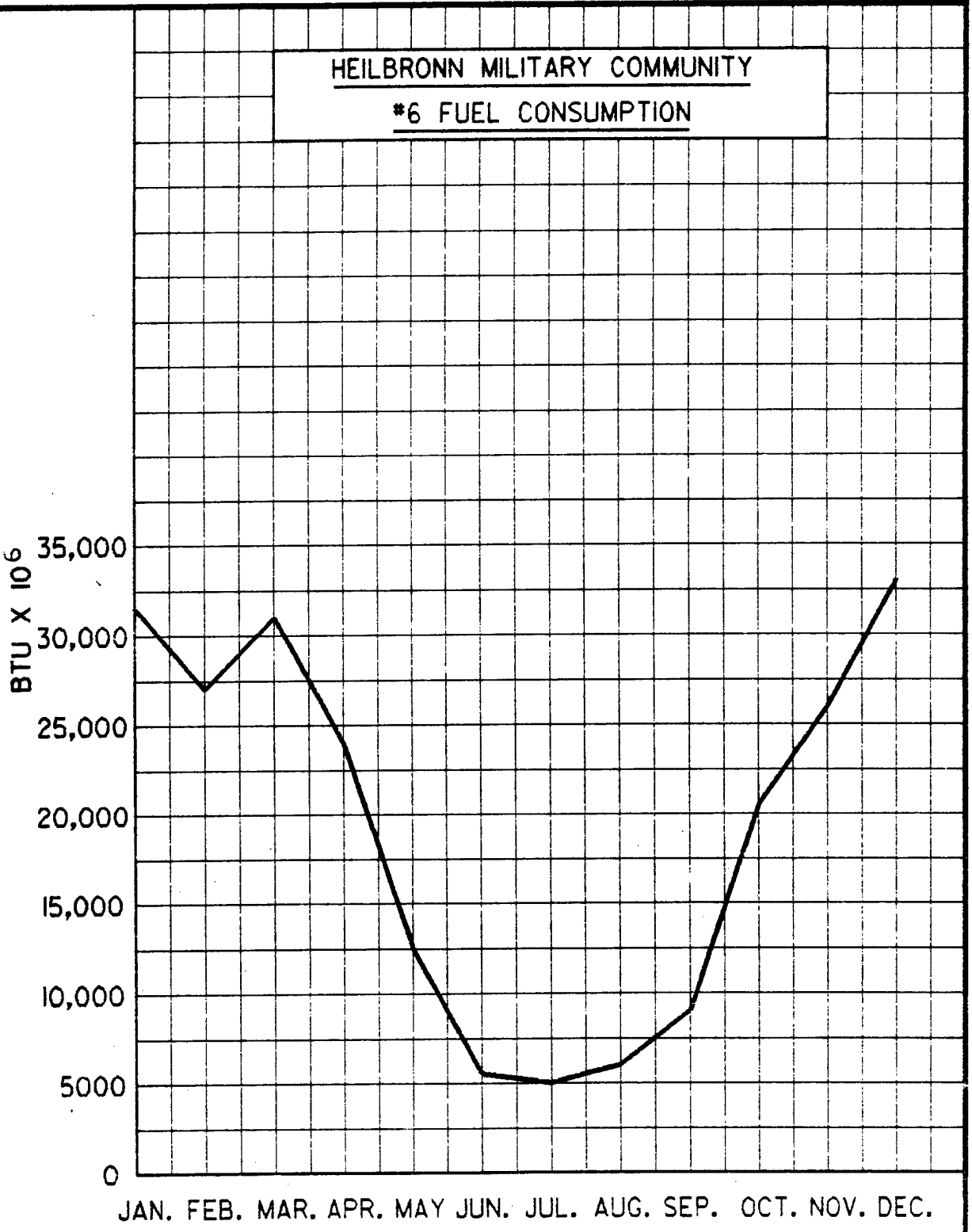

Chart 6-7

CORPS OF ENGINEERS

EUROPE DIVISION

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HEILBRONN MILITARY COMMUNITY

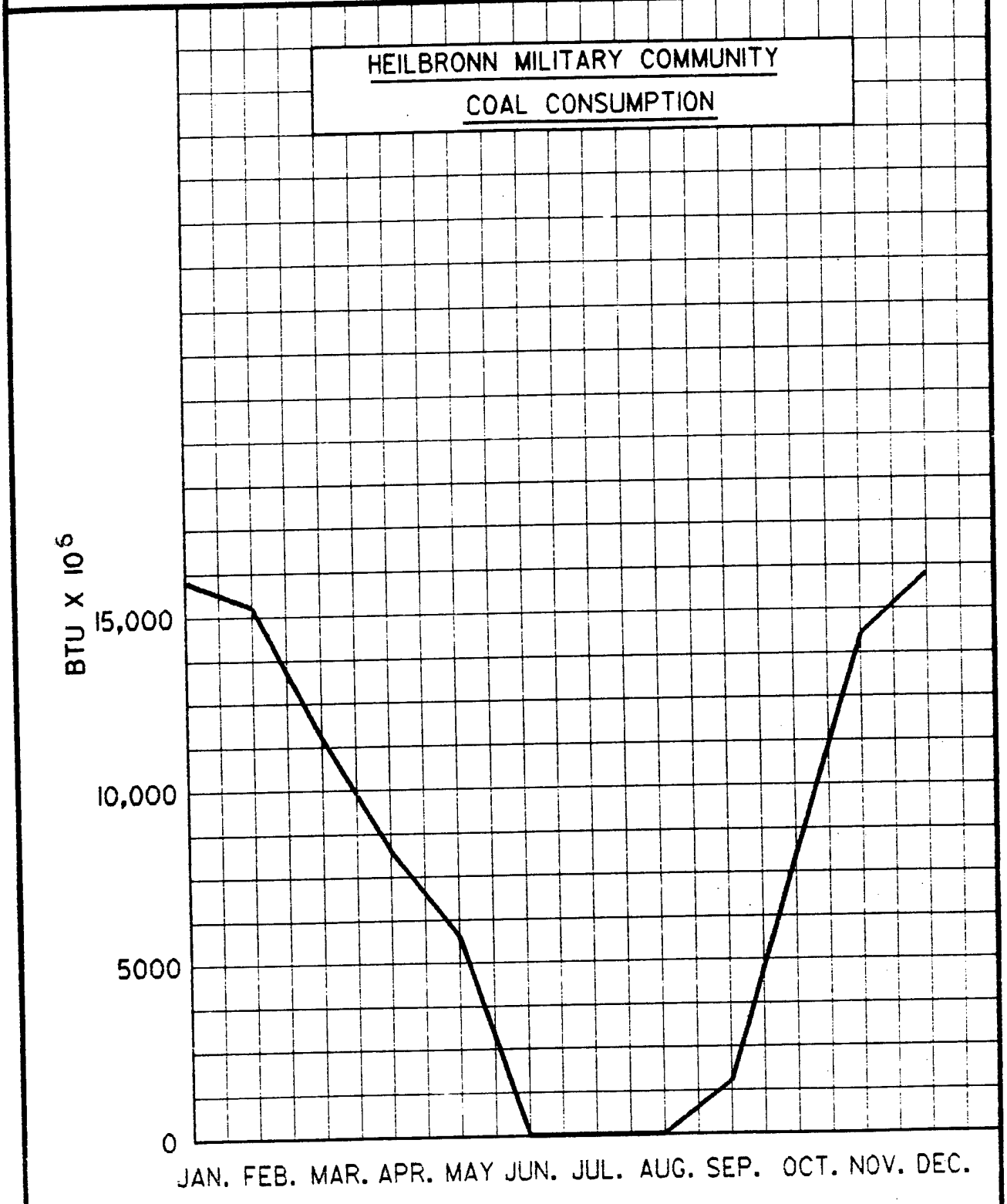
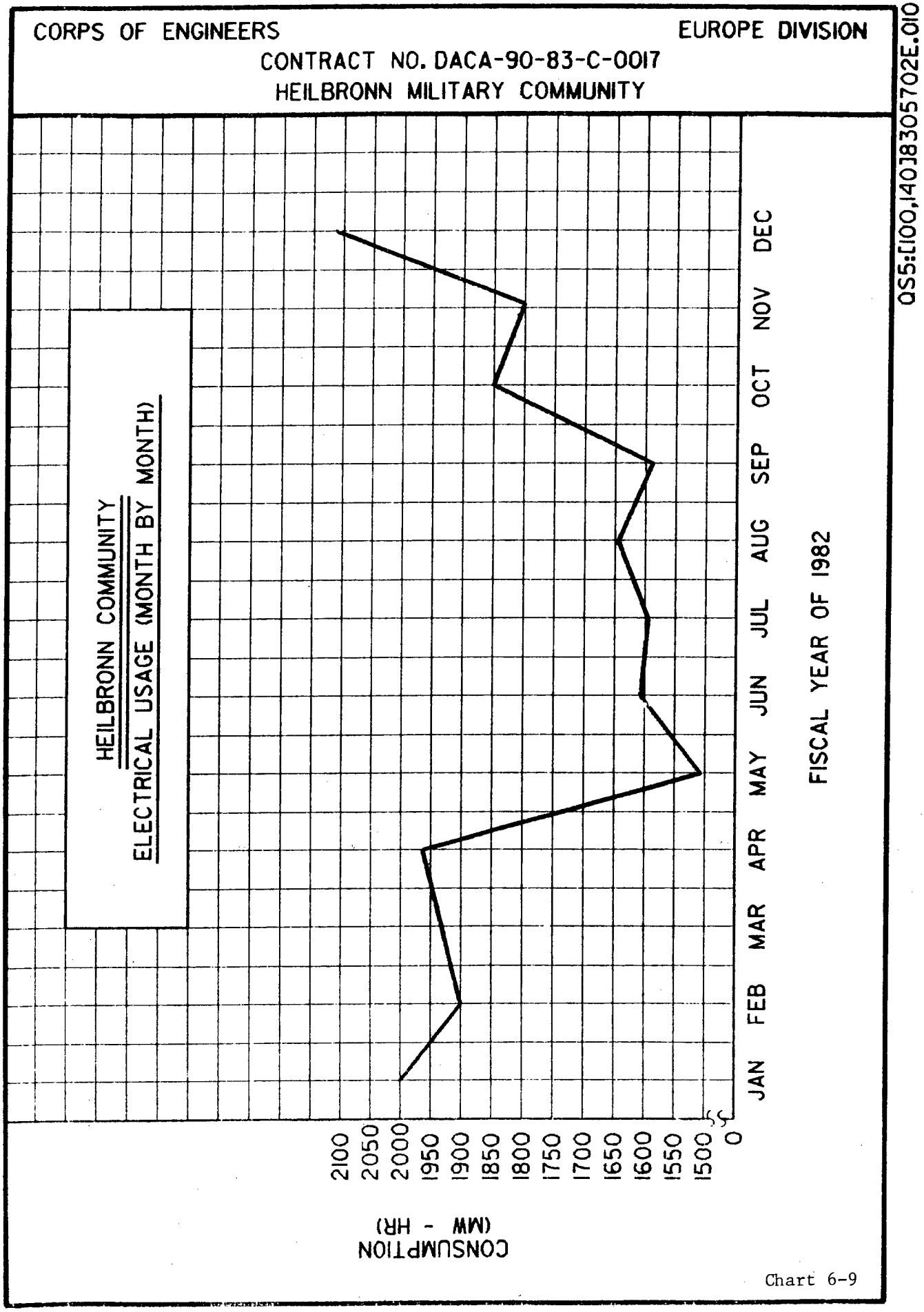


Chart 6-8


CORPS OF ENGINEERS
EUROPE DIVISION
CONTRACT NO. DACA-90-83-C-0017
HEILBRONN MILITARY COMMUNITY
HEILBRONN COMMUNITY
ELECTRICAL USAGE (MONTH BY MONTH)
CONSUMPTION
(MW - HR)
2100
2050
2000
1950
1900
1850
1800
1750
1700
1650
1600
1550
1500
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
FISCAL YEAR OF 1982
QS5:[100,140]8305702E.010
Chart 6-9

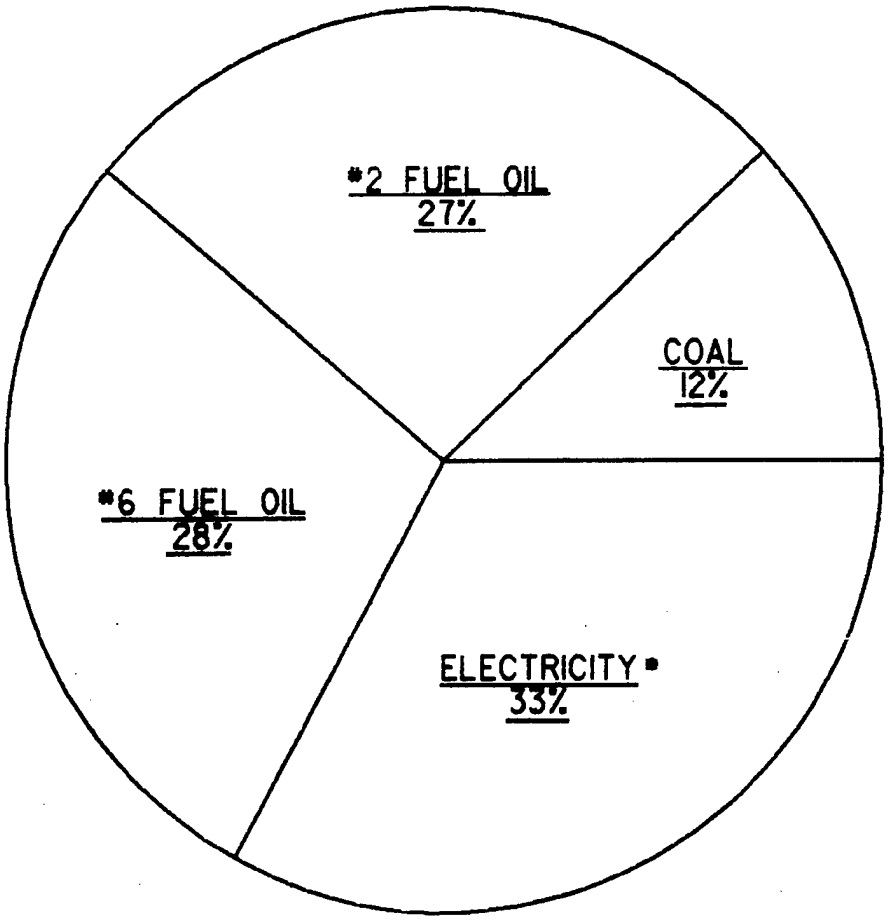
CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

% TOTAL ENERGY - BY ENERGY TYPE

(BASED ON PHASE I DATA FOR 1982)



TOTAL ENERGY CONSUMPTION = 815,566 $\frac{MBTU}{YR}$

* ELECTRICAL DATA WAS CONVERTED TO RAW ENERGY ($\frac{MBTU}{YR}$)

Figure 6-10

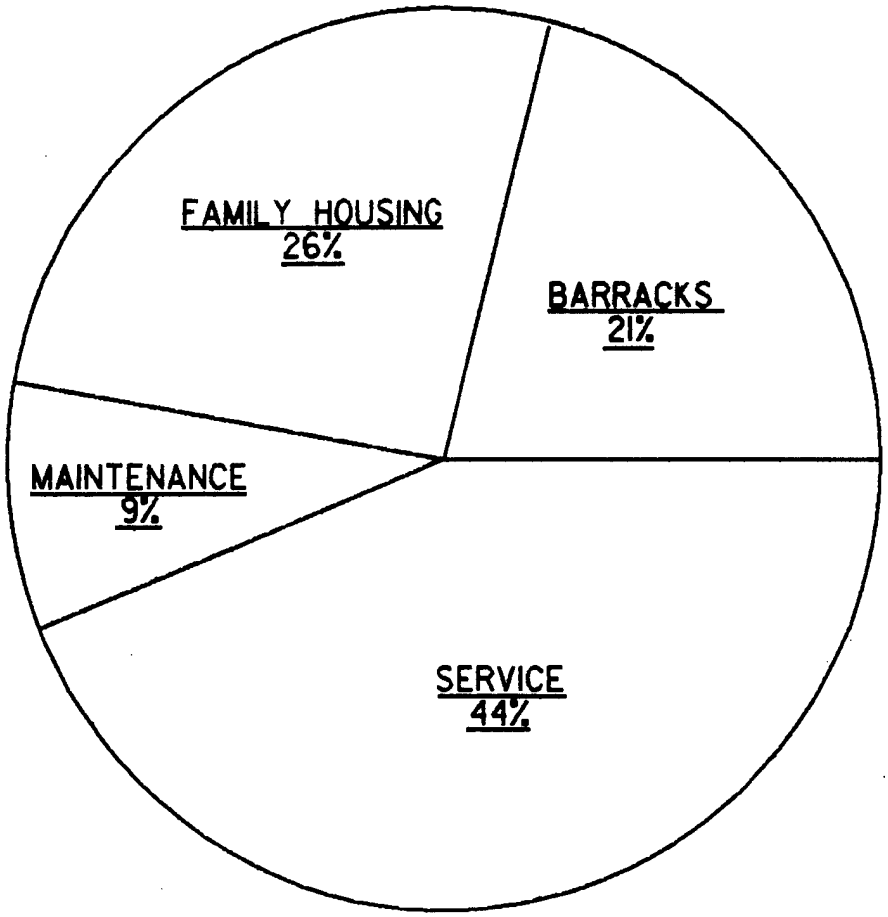
CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

ELECTRICAL CONSUMPTION - BY BUILDING TYPE

(BASED ON PHASE I DATA FOR 1982)



TOTAL CONSUMPTION = 22,969,250 $\frac{KWH}{YR}$

Figure 6-11

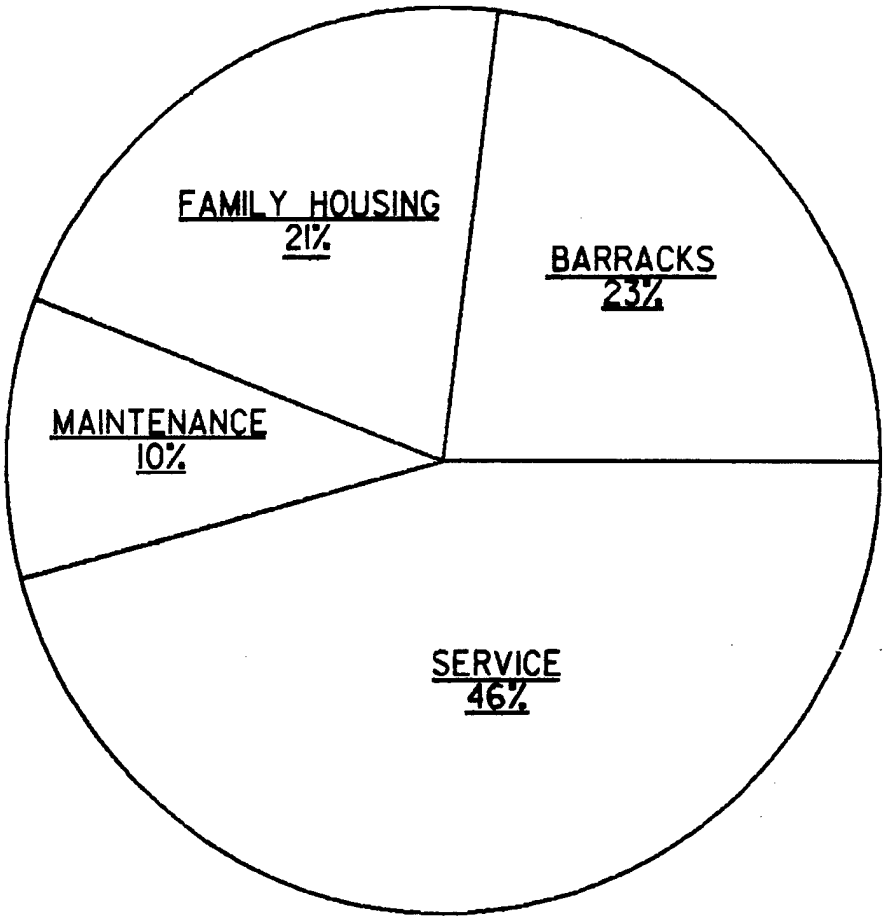
CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

#2 FUEL OIL CONSUMPTION - BY BUILDING TYPE

(BASED ON PHASE I DATA FOR 1982)



TOTAL CONSUMPTION = 218,316.2 $\frac{\text{MBTU}}{\text{YR}}$

Figure 6-12

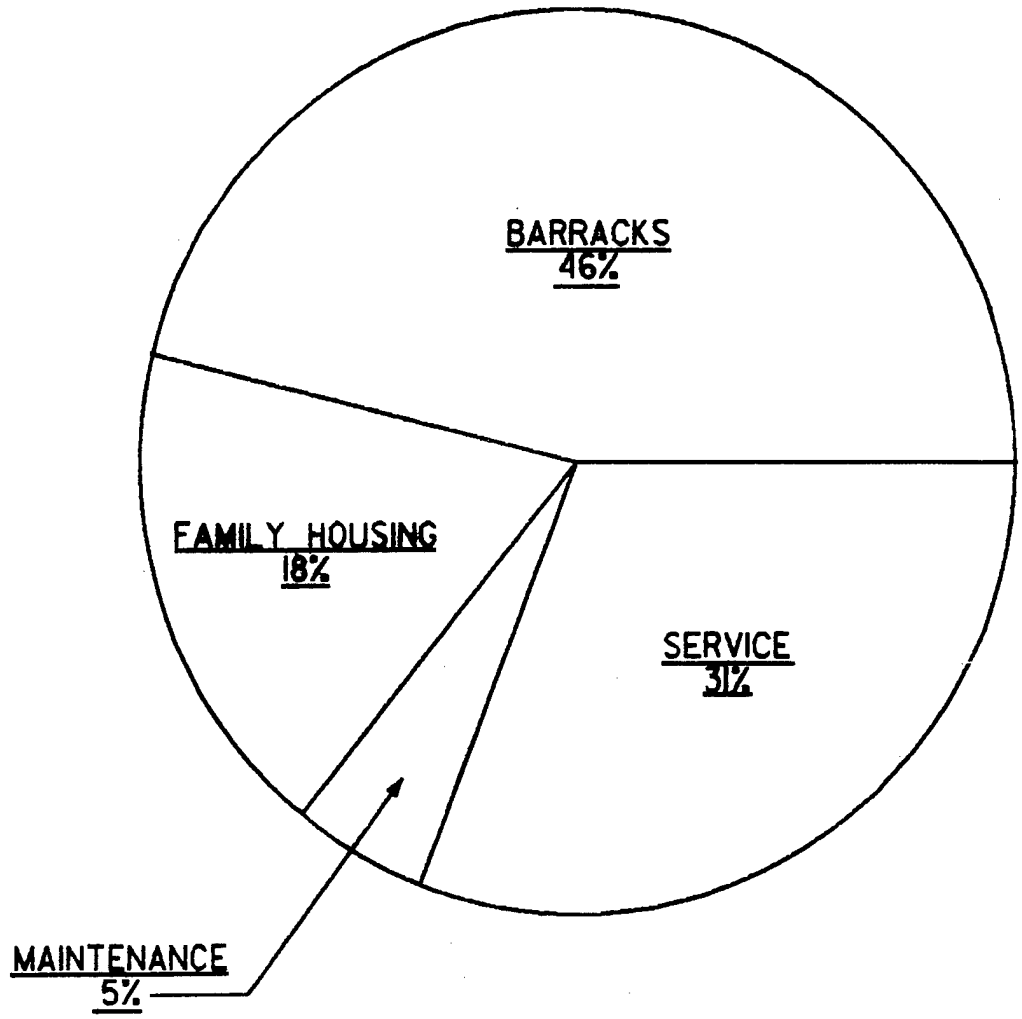
CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

#6 FUEL OIL CONSUMPTION - BY BUILDING TYPE

(BASED ON PHASE I DATA FOR 1982)



TOTAL CONSUMPTION = 233,273 $\frac{MBTU}{YR}$

Figure 6-13

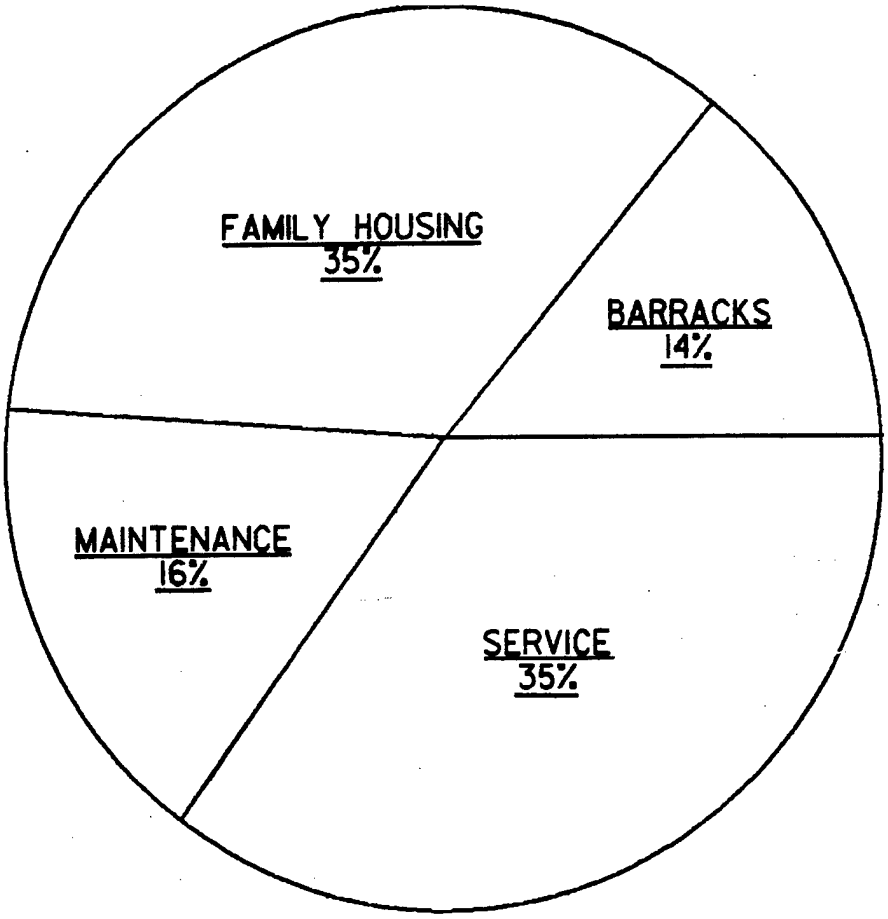
CORPS OF ENGINEERS EUROPE DIVISION

CONTRACT NO. DACA-90-83-C-0017

HEILBRONN MILITARY COMMUNITY

COAL CONSUMPTION - BY BUILDING TYPE

(BASED ON PHASE I DATA FOR 1982)



TOTAL CONSUMPTION = 97,533 $\frac{\text{MBTU}}{\text{YR}}$

Figure 6-14

7.1 Section Overview

Energy Monitoring and Control Systems have become wide spread for use on college campuses, military bases, industry and health care facilities in the United States. These systems are beginning to appear in some military communities in Europe.

The reliability of the Military Telephone Systems, on installations, is not generally suitable for use for EMCS. This condition exists mainly because very few wire systems have extra wire that can be used to transmit EMCS signals. For this reason, some military installations are employing FM radio for transmissions. Frequency assignment from the German Government is sometimes very slow. It takes as much as a year or longer to obtain frequencies. The alternative to FM radio is to install additional telephone cable systems in all affected areas and leasing telephone lines from the German Telephone Service for transmitting between Gy areas. This method obviously increases the installation cost, but is considered more reliable than radio. Weather conditions and mechanical failure are factors to consider when evaluating radio.

This section addresses the different uses for EMCS and the general composition of a typical system. The EMCS Tri-Service Guide Specification is used as the Basis for Design.

7.2 Potential Systems for Connection to an EMCS

An EMCS System can provide several functions at remote buildings from a central location. Among the services are:

a. Equipment monitoring, status (on or off) verification.

b. Alarm, indicating off-normal conditions or operational trends or shutdowns instantaneously when the occur.

c. Unattended systems can be cycled or modulated automatically.

d. System logging to reduce manual, time consuming trips to heating plants for logging.

e. Equipment start-stop by pre-set program or by choice manually. These functions can be sequential start-up, day-night set back and electrical load shedding.

f. Preliminary trouble shooting of off-normal conditions. This can reduce response time for maintenance service.

g. Trend logging of energy consumed thru logging BTU meters.

h. Maintenance Routine Programming. The system can announce requirement based on calander time or actual operating time.

i. Monitor critical systems - computer rooms or medical facilities.

j. Security systems can be intergrated with EMCS. These can be intrusion alarms through door and window switches, motion detection with TV cameras, fire alarms and perhaps other security needs.

k. Automatic resetting of boiler temperature as required by monitoring outdoor temperature.

l. Intercommunication from remote locations to the base point can be added.

m. Boiler stack gases can be monitored and recorded to aid maintenance personnel in keeping boilers operating at their best efficiency.

These systems are not intended to replace local control entirely. Firestats and thermostats within the buildings should remain in service. An EMCS is not a com plete replacement for visual inspection of facilities and equipment. Routine visits to equipment and heating plants will still be required to ascertain the exact nature of physical problems or material failures.

7.2.1 Applications

Heilbronn Military Community has no air conditioning for comfort purposes and the amount for special use is negligable. This greatly reduces the attractiveness of applying EMCS.

Campuses or communities with massive use of air conditioning are more likely to produce effective use for EMCS. Air conditioning air handlers can have EMCS controlled fresh air economizer systems and cycling of fans for demand load shedding. Also large motors used for refrigeration machines can be shut down, chilled water temperatures raised or maximum power draw regulated to reduce either demand or power consumption.

By the same measure, areas with high horsepower motors for purposes such as compressed air systems or large pumps can be duty cycled to reduce demand and/or consumption.

Very few of these conditions were observed in the Heilbronn community. For this reason, the application of EMCS on an economic basis becomes difficult. This study attempts to identify any potential and attempts to prove the energy saving and economic gain required to justify the system's application.

A major test for feasibility is the comparison of EMCS compared to receiving the same savings in energy and money by other means. These means are the use of time clocks, photo cells and local outdoor temperature reset controls. As previously stated, lighting, potable water heating, building comfort heating, boiler monitoring and clothes drying are the potentials for EMCS. Monitoring and managing these items will be evaluated in this report.

7.3 Description of Potential EMCS

The potential EMCS described, developed and estimated during Phase II is:

a. Central Process equipment with alarm printer and log printer located within the Director of Engineering and Housing facilities at Badenerhof Kaserne.

b. Each GY area would be equipped with a sub-system tied into the Master System at Badenerhof Kaserne.

c. Interconnection between the Master Central equipment and the satellite system would be by leased telephone pairs.

d. Local (GY area) wiring is included as part of the construction cost.

e. The main feature of this system is that if the Central Processor loses power or fails each GY area will continue to operate from its local satelite processor.

f. Intrusion detection or fire alarm systems are not included because they are not energy related. These features can be added singly and inexpensively during construction or at some future date. These features are not necessarily money saving but are convenient and should not cost any extra for operating; therefore, an attractive side benefit can be received with a very low investment.

g. The estimates for construction cost are done by GY area. This allows each GY area to be evaluated separately to determine if all areas can be justified or if any area can be justified separately. Consolidation to one large system throughout the community has a potential draw-back. This is the tactical disadvantage of dependency on exposed communication lines across the countryside.